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Thermocouple Reference Tables Based on the IPTS-68

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Thermocouple Reference Tables Based on the IPTS-68

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1. Introduction	1
1.1. General summary	1
1.2. Temperature scale and platinum thermoelectric reference standard, Pt-67	3
1.3. Mathematical methods	7
1.4. Material selection and application of data	8
1.5. Acknowledgments	10
1.6. References	10

Noble Metal Thermocouple Combinations

2. Type S: <i>Platinum</i> —10% rhodium alloy versus platinum thermocouples	13
2.1. Material specifications and precautions	13
2.2. Data analyses and comparisons	14
2.3. Reference functions and tables for Type S thermocouples	16
3. Type R: <i>Platinum</i> —13% rhodium alloy versus platinum thermocouples	31
3.1. Material specifications and precautions	31
3.2. Data analyses and comparisons	31
3.3. Reference functions and tables for Type R thermocouples	33
4. Type B: <i>Platinum</i> —30% rhodium alloy versus <i>platinum</i> —6% rhodium alloy thermocouples	47
4.1. Material specifications and precautions	47
4.2. Data analyses and comparisons	48
4.3. Reference functions and tables for Type B thermocouples	50
4.4. Reference functions and tables for the <i>positive</i> thermoelement, Type BP, a <i>platinum</i> —30% rhodium alloy versus platinum, Pt-67	64
4.5. Reference functions and tables for the <i>negative</i> thermoelement, Type BN, a <i>platinum</i> —6% rhodium alloy versus platinum, Pt-67	77

Base Metal Thermocouple Combinations

5. Type E: <i>Nickel</i> —chromium alloy versus <i>copper</i> —nickel alloy thermocouples	90
5.1. Material specifications and precautions	90
5.2. Data analyses and comparisons	90
5.3. Reference functions and tables for Type E thermocouples	92
Reference functions and tables for the <i>positive</i> thermoelement, Type EP, a <i>nickel</i> —chromium alloy versus platinum, Pt-67 (See section 7.4)	
Reference functions and tables for platinum, Pt-67, versus the <i>negative</i> thermoelement, Type EN, a <i>copper</i> —nickel alloy (See section 8.5)	
6. Type J: Iron versus <i>copper</i> —nickel alloy (SAMA) thermocouples	103
6.1. Material specifications and precautions	103
6.2. Data analyses and comparisons	104
6.3. Reference functions and tables for Type J thermocouples	107
6.4. Reference functions and tables for the <i>positive</i> thermoelement, Type JP, iron versus platinum, Pt-67	119
6.5. Reference functions and tables for platinum, Pt-67, versus the <i>negative</i> thermoelement, Type JN, a <i>copper</i> —nickel alloy	128
7. Type K: <i>Nickel</i> —chromium alloy versus <i>nickel</i> —aluminum alloy thermocouples	137
7.1. Material specifications and precautions	137
7.2. Data analyses and comparisons	138
7.3. Reference functions and tables for Type K thermocouples	140
7.4. Reference functions and tables for the <i>positive</i> thermoelement, Type KP, a <i>nickel</i> —chromium alloy versus platinum, Pt-67	153
7.5. Reference functions and tables for platinum, Pt-67, versus the <i>negative</i> thermoelement, Type KN, a <i>nickel</i> —aluminum alloy	166
8. Type T: Copper versus <i>copper</i> —nickel alloy thermocouples	179
8.1. Material specifications and precautions	179
8.2. Data analyses and comparisons	180
8.3. Reference functions and tables for Type T thermocouples	182

8.4. Reference functions and tables for the <i>positive</i> thermoelement, Type TP, copper versus platinum, Pt-67	189
8.5. Reference functions and tables for platinum, Pt-67, versus the <i>negative</i> thermoelement, Type TN, a <i>copper-nickel</i> alloy	196

Appendices

A1. General introduction	207
A2. Supplementary data for Type S— <i>Platinum-10% rhodium</i> alloy versus platinum thermocouples	208
A2.1. Data for voltage as a function of temperature	208
A2.2. Data for temperature as a function of voltage	220
A3. Supplementary data for Type R— <i>Platinum-13% rhodium</i> alloy versus platinum thermocouples	229
A3.1. Data for voltage as a function of temperature	229
A3.2. Data for temperature as a function of voltage	241
A4. Supplementary data for Type B— <i>Platinum-30% rhodium</i> alloy versus <i>platinum-6% rhodium</i> alloy thermocouples	251
A4.1. Data for voltage as a function of temperature	251
A4.2. Data for temperature as a function of voltage	262
A5. Supplementary data for Type E— <i>Nickel-chromium</i> alloy versus <i>copper-nickel</i> alloy thermocouples	269
A5.1. Data for voltage as a function of temperature	269
A5.2. Data for temperature as a function of voltage	277
A6. Supplementary data for Type J— <i>Iron</i> versus <i>copper-nickel</i> alloy (SAMA) thermocouples	309
A6.1. Data for voltage as a function of temperature	309
A6.2. Data for temperature as a function of voltage	320
A7. Supplementary data for Type K— <i>Nickel-chromium</i> alloy versus <i>nickel-aluminum</i> alloy thermocouples	351
A7.1. Data for voltage as a function of temperature	351
A7.2. Data for temperature as a function of voltage	361
A8. Supplementary data for Type T— <i>Copper</i> versus <i>copper-nickel</i> alloy thermocouples	385
A8.1. Data for voltage as a function of temperature	385
A8.2. Data for temperature as a function of voltage	390

List of Figures

Figure	Page
2.2.1. Deviations of thermoelectric voltages of Type S thermocouples—comparisons of values given in this Monograph to those for typical thermocouples which conform to the previous Type S standard (NBS Circular 561)	15
2.2.2. Deviation of thermoelectric voltages of Type S thermocouples—comparison of values given in this Monograph to experimental data by Bedford et al. (1972)	15
2.2.3. Difference in thermoelectric voltages for Type S thermocouples—comparison of values given in this Monograph to those given in: NBS Circular 561; BSI (B.S. 1826:1952)	15
2.3.1. Thermoelectric voltage for Type S thermocouples	16
2.3.2. Seebeck coefficient for Type S thermocouples	16
2.3.3. Second derivative of thermoelectric voltage for Type S thermocouples	17
3.2.1. Deviations of thermoelectric voltage of Type R thermocouples—comparison of values given in this Monograph to those for typical thermocouples which conform to the previous Type R standard (NBS Circular 561)	32
3.2.2. Deviation of thermoelectric voltages of Type R thermocouples—comparison of values given in this Monograph to experimental data by Bedford et al. (1972)	32
3.2.3. Differences in thermoelectric voltages for Type R thermocouples—comparison of values given in this Monograph to those given in NBS Circular 561; BSI (B.S. 1826:1962)	32
3.3.1. Thermoelectric voltage for Type R thermocouples	33
3.3.2. Seebeck coefficient for Type R thermocouples	33
3.3.3. Second derivative of thermoelectric voltage for Type R thermocouples	34
4.2.1. Deviations in thermoelectric voltages of Type B thermocouples—comparison of values given in this Monograph to those given for thermocouples A, B, and C by Burns and Gallagher (1966)	49
4.2.2. Deviations of thermoelectric voltages of Type BP thermoelements versus platinum, Pt-67—comparison of values given in this Monograph to those given for thermocouple materials A, B, and C by Burns and Gallagher (1966)	49
4.2.3. Deviations of thermoelectric voltages of Type BN thermoelements versus platinum, Pt-67—comparison of values given in this Monograph to those given for thermocouple materials A, B, and C by Burns and Gallagher (1966)	49
4.2.4. Difference in thermoelectric voltages for Type B thermocouples—comparison of values given in this Monograph to those from Burns and Gallagher (1966)	50
4.3.1. Thermoelectric voltage for Type B thermocouples	51
4.3.2. Seebeck coefficient for Type B thermocouples	51

4.3.3.	Second derivative of thermoelectric voltage for Type B thermocouples	51
4.4.1.	Thermoelectric voltage for Type BP thermoelements versus platinum, Pt-67	64
4.4.2.	Seebeck coefficient for Type BP thermoelements versus platinum, Pt-67	64
4.4.3.	Second derivative of thermoelectric voltage for Type BP thermoelements versus platinum, Pt-67	64
4.5.1.	Thermoelectric voltage for Type BN thermoelements versus platinum, Pt-67	77
4.5.2.	Seebeck coefficient for Type BN thermoelements versus platinum, Pt-67	77
4.5.3.	Second derivative of thermoelectric voltage for Type BN thermoelements versus platinum, Pt-67	77
5.2.1.	Differences in thermoelectric voltages for Type E thermocouples—comparison of values given in this Monograph to those given in NBS Circular 561	91
5.3.1.	Thermoelectric voltage for Type E thermocouples	92
5.3.2.	Seebeck coefficient for Type E thermocouples	92
5.3.3.	Second derivative of thermoelectric voltage for Type E thermocouples	92
6.2.1.	Deviations of thermoelectric voltages of Type J thermocouples	105
6.2.2.	Deviations of thermoelectric voltages of Type JP thermoelements versus platinum, Pt-67	105
6.2.3.	Deviations of thermoelectric voltages of platinum, Pt-67, versus JN thermoelements	106
6.2.4.	Differences in the thermoelectric voltages for Type J thermocouples—comparison of values given in this Monograph to those given in NBS Circular 561	106
6.3.1.	Thermoelectric voltage for Type J thermocouples	107
6.3.2.	Seebeck coefficient for Type J thermocouples	107
6.3.3.	Second derivative of thermoelectric voltage for Type J thermocouples	107
6.4.1.	Thermoelectric voltage for Type JP thermoelements versus platinum, Pt-67	119
6.4.2.	Seebeck coefficient for Type JP thermoelements versus platinum, Pt-67	119
6.4.3.	Second derivative of thermoelectric voltage for Type JP thermoelements versus platinum, Pt-67	119
6.5.1.	Thermoelectric voltage for platinum, Pt-67, versus Type JN thermoelements	128
6.5.2.	Seebeck coefficient for platinum, Pt-67, versus Type JN thermoelements	128
6.5.3.	Second derivative of thermoelectric voltage for platinum, Pt-67, versus Type JN thermoelements	128
7.2.1.	Deviations of thermoelectric voltages of Type K thermocouples	139
7.2.2.	Deviations of thermoelectric voltages of Type KP (or EP) thermoelements versus platinum, Pt-67	139
7.2.3.	Deviations of the thermoelectric voltages of platinum, Pt-67, versus Type KN thermoelements	139
7.2.4.	Differences in the thermoelectric voltages for Type K thermocouples—comparison of values given in this Monograph to those given in NBS Circular 561	140
7.3.1.	Thermoelectric voltage for Type K thermocouples	140
7.3.2.	Seebeck coefficient for Type K thermocouples	141
7.3.3.	Second derivative of thermoelectric voltage for Type K thermocouples	141
7.4.1.	Thermoelectric voltage for Type KP (or EP) thermoelements versus platinum, Pt-67	153
7.4.2.	Seebeck coefficient for Type KP (or EP) thermoelements versus platinum, Pt-67	153
7.4.3.	Second derivative of thermoelectric voltage for Type KP (or EP) thermoelements versus platinum, Pt-67	153
7.5.1.	Thermoelectric voltage for platinum, Pt-67, versus Type KN thermoelements	166
7.5.2.	Seebeck coefficient for platinum, Pt-67, versus Type KN thermoelements	166
7.5.3.	Second derivative of thermoelectric voltage for platinum, Pt-67, versus Type KN thermoelements	166
8.2.1.	Deviations of the thermoelectric voltages of Type T thermocouples	181
8.2.2.	Deviations in the thermoelectric voltage of Type TP thermoelements versus platinum, Pt-67	181
8.2.3.	Deviations in the thermoelectric voltages of platinum, Pt-67, versus Type TN (or EN) thermoelements	181
8.2.4.	Difference in the thermoelectric voltages for Type T thermocouples—comparison of values given in this Monograph to those given in NBS Circular 561	182
8.3.1.	Thermoelectric voltage for Type T thermocouples	182
8.3.2.	Seebeck coefficient for Type T thermocouples	183
8.3.3.	Second derivative of thermometric voltage for Type T thermocouples	183
8.4.1.	Thermoelectric voltage for Type TP thermoelements versus platinum, Pt-67	190
8.4.2.	Seebeck coefficient for Type TP thermoelements versus platinum, Pt-67	190
8.4.3.	Second derivative of thermoelectric voltage for Type TP thermoelements versus platinum, Pt-67	190
8.5.1.	Thermoelectric voltage for platinum, Pt-67, versus Type TN (or EN) thermoelements	197
8.5.2.	Seebeck coefficient for platinum, Pt-67, versus Type TN (or EN) thermoelements	197
8.5.3.	Second derivative of thermoelectric voltage for platinum, Pt-67, versus Type TN (or EN) thermoelements	197

List of Tables

Table		
1.1.1.	Thermocouple characteristics	2
1.2.1.	Defining fixed points of the IPTS-68	4
1.2.2.	Secondary reference points of the IPTS-68	5
1.2.3.	Approximate differences between IPTS-68 and IPTS-48; values tabulated are ($T_{68} - T_{48}$) K	6
1.2.4.	Chemical composition of platinum, Pt-67	6

Table	Page
2.3.1. Power series expansion of the thermoelectric voltage of Type S thermocouples	17
2.3.2. Type S thermocouples—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	18
2.3.3. Thermoelectric values at the fixed points for Type S thermocouples	
2.3.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type S thermocouples	29
3.3.1. Power series expansion for the thermoelectric voltage of Type R thermocouples	34
3.3.2. Type R thermocouples—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients dS/dT , reference junctions at 0 °C	35
3.3.3. Thermoelectric values at the fixed points for Type R thermocouples	46
3.3.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type R thermocouples	46
4.2.1. Deviations in thermoelectric voltage between tabular values in this Monograph and the earlier Degussa calibration for Type B thermocouples	50
4.3.1. Power series expansion for the thermoelectric voltage of Type B thermocouples	51
4.3.2. Type B thermocouples—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	52
4.3.3. Thermoelectric values at the fixed points for Type B thermocouples	63
4.3.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type B thermocouples	63
4.4.1. Power series expansion for the thermoelectric voltage of Type BP thermoelements versus platinum, Pt-67	64
4.4.2. Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	65
4.4.3. Thermoelectric values at the fixed points for Type BP thermoelements versus platinum, Pt-67	76
4.4.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type BP thermoelements versus platinum, Pt-67	76
4.5.1. Power series expansion for the thermoelectric voltage of the Type BN thermoelements versus platinum, Pt-67 ...	77
4.5.2. Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	78
4.5.3. Thermoelectric values at the fixed points for Type BN thermoelements versus platinum, Pt-67	89
4.5.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type BN thermoelements versus platinum, Pt-67	89
5.3.1. Power series expansion for the thermoelectric voltage of Type E thermocouples	93
5.3.2. Type E thermocouples—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junction at 0 °C	94
5.3.3. Thermoelectric values at the fixed points for Type E thermocouples	102
5.3.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the powers series expansion for the thermoelectric voltage of Type E thermocouples	102
6.3.1. Power series expansion for the thermoelectric voltage of Type J thermocouples	107
6.3.2. Type J thermocouples—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	108
6.3.3. Thermoelectric values at the fixed points for Type J thermocouples	118
6.3.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type J thermocouples	118
6.4.1. Power series expansion for the thermoelectric voltage of Type JP thermoelements versus platinum, Pt-67	119
6.4.2. Type JP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	120
6.4.3. Thermoelectric values at the fixed points for Type JP thermoelements versus platinum, Pt-67	127
6.4.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type JP thermoelements versus platinum, Pt-67	127
6.5.1. Power series expansion for the thermoelectric voltage of platinum, Pt-67, versus Type JN thermoelements	128
6.5.2. Platinum, Pt-67, versus Type JN thermoelements—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	129
6.5.3. Thermoelectric values at the fixed points for platinum, Pt-67, versus Type JN thermoelements	136
6.5.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of platinum, Pt-67, versus JN thermoelements	136
7.3.1. Power series expansion for the thermoelectric voltage of Type K thermocouples	141
7.3.2. Type K thermocouples—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	142
7.3.3. Thermoelectric values at the fixed points for Type K thermocouples	152
7.3.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type K thermocouples	152

7.4.1.	Power series expansion for the thermoelectric voltage of Type KP (or EP) thermoelements versus platinum, Pt-67	154
7.4.2.	Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	155
7.4.3.	Thermoelectric values at the fixed points for Type KP (or EP) thermoelements versus platinum, Pt-67	165
7.4.4.	Estimated maximum errors that occur when using reduced-bit arithmetic for the powers series expansion for the thermoelectric voltage for Type KP (or EP) thermoelements versus platinum, Pt-67	165
7.5.1.	Power series expansions for the thermoelectric voltage of platinum, Pt-67, versus Type KN thermoelements	167
7.5.2.	Platinum, Pt-67, versus Type KN thermoelements— thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	168
7.5.3.	Thermoelectric values at the fixed points for platinum, Pt-67, versus Type KN thermoelements	178
7.5.4.	Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of platinum, Pt-67, versus Type KN thermoelements	178
8.3.1.	Power series expansion for the thermoelectric voltage of Type T thermocouples	183
8.3.2.	Type T thermocouples—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	184
8.3.3.	Thermoelectric values at the fixed points for Type T thermocouples	189
8.3.4.	Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type T thermocouples	189
8.4.1.	Power series expansion for the thermoelectric voltage of Type TP thermoelements versus platinum, Pt-67	190
8.4.2.	Type TP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	191
8.4.3.	Thermoelectric values at the fixed points for Type TP thermoelements versus platinum, Pt-67	196
8.4.4.	Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type TP thermoelements versus platinum, Pt-67	196
8.5.1.	Power series expansion for the thermoelectric voltage of platinum, PtX67, versus Type TN (or EN) thermoelements.	197
8.5.2.	Platinum, Pt-67, versus Type TN (or EN) thermoelements—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C	198
8.5.3.	Thermoelectric values at the fixed points for platinum, Pt-67, versus type TN (or EN) thermoelements	206
8.5.4.	Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of platinum, Pt-67, versus Type TN (or EN) thermoelements	206
A2.1.1.	Type S thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C ..	208
A2.1.2.	Type S thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F ...	212
A2.1.3.	Type S thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature (°C) in selected temperatures ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius	219
A2.2.1.	Type S thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C	220
A2.2.2.	Type S thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F ..	224
A2.2.3.	Type S thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges (°C). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius	228
A3.1.1.	Type R thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C ..	229
A3.1.2.	Type R thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F ..	233
A3.1.3.	Type R thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature (°C) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius	240
A3.2.1.	Type R thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C ..	241
A3.2.2.	Type R thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F ..	246
A3.2.3.	Type R thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges (°C). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius.	250
A4.1.1.	Type B thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C ..	252
A4.1.2.	Type B thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F ..	255
A4.1.3.	Type B thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature (°C) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius	261
A4.2.1.	Type B thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C	263
A4.2.2.	Type B thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F ..	266
A4.2.3.	Type B thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges (°C). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius	268

Table	Page
A5.1.1. Type E thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C ..	269
A5.1.2. Type E thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F ..	272
A5.1.3. Type E thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature ($^{\circ}\text{C}$) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius	276
A5.2.1. Type E thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C ...	277
A5.2.2. Type E thermocouples—temperature ($^{\circ}\text{F}$) as a function of thermoelectric voltage, reference junctions at 32°F ..	292
A5.2.3. Type E thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges ($^{\circ}\text{C}$). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius	307
A6.1.1. Type J thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C ...	309
A6.1.2. Type J thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F ..	612
A6.1.3. Type J thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature ($^{\circ}\text{C}$) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius	319
A6.2.1. Type J thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C ...	320
A6.2.2. Type J thermocouples—temperature ($^{\circ}\text{F}$) as a function of thermoelectric voltage, reference junctions at 32°F ..	335
A6.2.3. Type J thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges ($^{\circ}\text{C}$). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius	350
A7.1.1. Type K thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C ...	351
A7.1.2. Type K thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F ..	355
A7.1.3. Type K thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature ($^{\circ}\text{C}$) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius	360
A7.2.1. Type K thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C ...	361
A7.2.2. Type K thermocouples—temperature ($^{\circ}\text{F}$) as a function of thermoelectric voltage, reference junctions at 32°F ..	373
A7.2.3. Type K thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges ($^{\circ}\text{C}$). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius	384
A8.1.1. Type T thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C ...	385
A8.1.2. Type T thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F ..	387
A8.1.3. Type T thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature ($^{\circ}\text{C}$) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius	389
A8.2.1. Type T thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C ...	390
A8.2.2. Type T thermocouples—temperature ($^{\circ}\text{F}$) as a function of thermoelectric voltage, reference junctions at 32°F ..	396
A8.2.3. Type T thermocouples—quadratic, cubic and quartic approximations to the data as a function of voltage in selected temperature ranges ($^{\circ}\text{C}$). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius	401

Thermocouple Reference Tables Based on the IPTS-68

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Revision of the International Practical Temperature Scale requires that there be changes for all accurately tabulated thermophysical values. Revised reference data for thermocouples have been generated in a cooperative program between groups of the National Bureau of Standards in Boulder and Gaithersburg. This Monograph contains tables, analytic expressions, various approximations, and explanatory text. Only the standard letter-designated thermocouples are described: noble metal Types S, R, and B and base metal Types E, J, K, and T. Their appropriate "single-leg" or thermocouple versus Pt-67 values are also included. The new reference data reflect not only revisions in the temperature scale, but also slight changes in the materials themselves and improvements in data fitting methods. The temperature ranges vary for different types, from a low of -270°C for Type E to a high of 1820°C for Type B. The main functions and tables are given in terms of Celsius degrees and microvolts. Tables in the appendices represent the data with less precision, in millivolts, and in degrees Fahrenheit as well as Celsius. Approximate quadratic, cubic, and quartic analytic expressions are also given for each thermocouple type in various temperature ranges.

Key words: Base metal alloys; noble metal alloys; temperature scale; temperature standards; thermocouples; thermometry.

I. Introduction

1.1. General Summary

Adoption of the new temperature scale, IPTS-68, requires that all accurate thermophysical data be adjusted to fit the new temperatures. Although, as of July 1972, no national laboratory had fully realized the new scale, as many thermometry calibrations as possible are being revised. The new scale depends on a large number of primary and secondary fixed points with designated interpolation equations and devices for obtaining intermediate temperatures. Hust [1969]* has written an extensive review and compilation of temperature scales, with an emphasis on temperatures below 0°C , that includes suggested methods of converting from older scales to present ones. A brief review of changes in the temperature scale is included in the next section. The new thermocouple reference data are based on the IPTS-68 for temperatures above 20 K (-253°C) and on the NBS helium-gas acoustic velocity scale from 4 to 20 K. The latter is referred to as NBS P 2-20 (1965), and is a national practical scale maintained by germanium thermometers in the Temperature Section of the National Bureau of Standards in Gaithersburg. The IPTS-68 is not defined down to liquid helium temperatures, but the NBS P 2-20 (1965) provides a workable scale from 2 to 20 K.

Even if the temperature scale had not been changed, the old tables in NBS Circular 561 [Shenker et al., 1955] might well have been changed for other reasons: there have been significant modifications in the chemical composition of some of the materials; a new platinum thermoelectric reference standard has been adopted; reference values for each material, both positive and negative legs of the thermocouple type, are needed for calibration and production control to insure interchangeability; greater precision in thermom-

etry instrumentation has led to a need for smoother tables and also for values of the derivatives; and the prevalence of computer-aided numerical analysis requires functional representations and approximations. There was also a change in the voltage reference, but the new "NBS as-maintained volt", NBS Tech. News Bull. [1968b], is so little different from the old voltage standard that the change does not significantly affect thermocouple tables. Values in this Monograph reflect the above changes and needs.

Close cooperation with wire manufacturers and instrument suppliers was insured by formation of an ad hoc advisory committee within the American Society for Testing and Materials (ASTM) chaired by D. I. Finch. Several potential trouble areas were resolved during their preliminary reviews. About eighteen people received and commented on preliminary copies of the tables, functions, and graphs.

In the following paragraphs, the sources of thermocouple data, the methods of numerical analysis, and the types of tables, graphs, and functions are summarized. Table 1.1.1 gives a list of the standard thermocouple materials included in this Monograph, a description of their composition and representative trade names, and the range of temperatures for each type.

Four main sources of data were used in generating the new functions and tables: (1) earlier publications containing original research data, (2) unpublished calibration certificates from the files of the Temperature Section of the National Bureau of Standards in Gaithersburg, (3) low-temperature functions published by Sparks et al. [1972] in NBS Monograph 124, and (4) adjusted values from old thermocouple tables such as NBS Circular 561. Further comments for each thermocouple type are given in each appropriate chapter. In summary, much of the fundamental data for generating the new thermocouple tables comes from

* References cited are listed in section 1.6.

TABLE 1.1.1. *Thermocouple characteristics*

THERMOCOUPLE COMBINATIONS

Type designation ^a	Temperature Range, °C	Materials
B	0 to 1820	<i>Platinum-30% rhodium versus platinum-6% rhodium.</i>
E	-270 to 1000	<i>Nickel-chromium alloy versus a copper-nickel alloy.</i>
J	-210 to 1200	<i>Iron versus another slightly different copper-nickel alloy.</i>
K	-270 to 1372	<i>Nickel-chromium alloy versus nickel-aluminum alloy.</i>
R	-50 to 1767	<i>Platinum-13% rhodium versus platinum.</i>
S	-50 to 1767	<i>Platinum-10% rhodium versus platinum.</i>
T	-270 to 400	<i>Copper versus a copper-nickel alloy.</i>

SINGLE-LEG MATERIALS

...N	The negative wire in a combination.
...P	The positive wire in a combination.
BN	<i>Platinum-nominal 6 wt% rhodium.</i>
BP	<i>Platinum-nominal 30 wt% rhodium.</i>
EN or TN	A <i>copper-nickel alloy</i> , constantan: Cupron ¹ , Advance ³ , ThermoKanthal JN ² ; nominally 55% Cu, 45% Ni; often referred to as Adams constantan.
EP or KP	A <i>nickel-chromium alloy</i> : Chromel ⁴ , Tophel ¹ , T-1 ³ , ThermoKanthal KP ² ; nominally 90% Ni, 10% Cr.
JN	A <i>copper-nickel alloy</i> similar to, but not always interchangeable with, EN and TN; SAMA specification.
JP	Iron: ThermoKanthal JP ² ; nominally 99.5% Fe.
KN	A <i>nickel-aluminum alloy</i> : Alume ¹ , Nial ¹ , T-2 ³ , ThermoKanthal KN ² ; nominally 95% Ni, 2% Al, 2% Mn, 1% Si.
RN, SN	High-purity platinum.
RP	<i>Platinum-13 wt% rhodium.</i>
SP	<i>Platinum-10 wt% rhodium.</i>
TP	Copper, usually Electrolytic Tough Pitch.

^a The letter designations used in this Monograph follow the recommendations of Committee E-20 of the American Society for Testing and Materials. The letter type, e.g., Type T, designates the thermoelectric properties, not the precise chemical composition. Thermocouples of a given type may have variations in composition as long as the resultant thermoelectric properties remain within the established limits of error.

Registered Trademarks:

- ¹ Trademark—Wilbur B. Driver Co.
- ² Trademark—Kanthal Corp.
- ³ Trademark—Driver-Harris Co.
- ⁴ Trademark—Hoskins Manufacturing Co.

The use of trade names does not constitute an endorsement of any manufacturer's products. All materials manufactured in compliance with the established thermoelectric voltage standards are equally acceptable.

published research papers, but also there was extensive use of unpublished calibrations and test data. Values for Types S, R, and B and most of Type J are also based on published research.

After general introductory material, discussions for each type of thermocouple are included in each chapter. The text covers such items as recommended temperature ranges, nominal chemical composition, special precautions on usage, and other similar descriptions not usually included with tables. For each type of

material, there are four classes of numerical information: functional representations, complete tables, abbreviated tables, and various approximations. The abbreviated tables and approximations appear in the appendices.

Functional representations are given in tables in the form of coefficients for power series expansions. For Type K only, additional parameters for an exponential term are also included. Orders of the series expansions range from two to fourteen. The functions can be used

directly for calculating thermal voltages as they were in this Monograph. However, for values at the highest temperatures and for high orders, there may be round-off errors on some computers that have relatively few binary bits in their floating point routines. Tables give the round-off errors that would occur for computers that have 12, 16, 24, or 27 binary bits (about 4, 5, 7, or 8 digits) in the coefficient of their floating point numbers. The tables in this Monograph were generated using 36 binary bit (about 11 digit) arithmetic routines. Generally the round-off error is insignificant for machines with 24 bits or more.

Functions, and complete tables also, are given for both the total thermocouple combination, such as Type K, and the single-leg combinations, such as Types KP and KN.

With some exceptions, the complete tables include the thermal voltage, E , (usually to the nearest 0.1 or 0.01 microvolt), the Seebeck coefficient, S , (0.001 $\mu\text{V}/^\circ\text{C}$), and the temperature derivative of the Seebeck coefficient, dS/dT (0.01 nV/ $^\circ\text{C}^2$), all as a function of temperature, which is given at one degree intervals for each of the appropriate temperature ranges. Values for one thermocouple combination, Type J, are given with reduced precision at temperatures which are above the transformation temperature of the JP material, 760 $^\circ\text{C}$. Since many calibrations are performed at the primary and secondary fixed-point temperatures on the IPTS-68, tables which give values of E , S , and dS/dT at various fixed points are also included. Two sets of figures show (1) deviations between the new and old standard tabular values and (2) deviations between the new tabular values and experimental values for typical thermocouples that represent present-day material.

Abbreviated tables for each type of material give voltage only (0.1 or 1 μV) as a function of temperature (1 $^\circ\text{C}$ or $^\circ\text{F}$) and the reverse, temperature (0.01 $^\circ\text{C}$ or $^\circ\text{F}$) as a function of voltage (0.01 mV). Those tables are in the appendices. Additional "three-place" (0.001 mV or 1 μV) tables, not included in this Monograph, have been produced and were made available at cost to the ASTM and wire manufacturers for their publication of special industrial tables.

To satisfy various special needs, e.g., for small on-line computers or for desk calculators, we have generated low-order approximations to the voltage versus temperature equation for each thermocouple type in a few representative temperature ranges. For example, there are voltage to temperature (and the reverse) approximations for Type B thermocouples in twelve different temperature ranges for second, third, and fourth order. Quadratic equations suitable for calculating variable reference junction corrections are also included. Coefficients and the range of errors are given for all approximations. A similar project was carried out a few years ago by Fazzalari and Leonette [1969] who based their approximations on values from NBS Circular 561.

1.2. Temperature Scale and Platinum Thermoelectric Reference Standard, Pt-67

Temperatures above 20 K are expressed on the International Practical Temperature Scale adopted in 1968, IPTS-68. Below 20 K, temperatures are expressed on the National Bureau of Standards acoustical temperature scale, NBS P 2-20 (1965). The definitions of these scales and differences from earlier scales are briefly discussed below.

During October 1968 the International Committee of Weights and Measures adopted the new International Practical Temperature Scale designated as IPTS-68 [CIPM, 1969]. This scale is defined in terms of a series of fixed points, a resistance versus temperature function, and interpolation formulas for specified instruments used to realize the scale. The defining fixed points, extending from 13.81 K to 1337.58 K, are given in table 1.2.1. The secondary fixed points are tabulated in table 1.2.2. In the interest of brevity the detailed description of the IPTS-68 is omitted here; however, the reader can find the details in the above reference.

The NBS P 2-20 (1965) temperature scale is described by Plumb and Cataland [1965a, b, 1966]. This scale, based on acoustical thermometry, extends from 2 to 20 K.

The tabulated voltages in these thermocouple tables differ from previous standard reference tables for several reasons, including changes in the defining temperature scale. Other causes for change are discussed in later sections. The differences between the current scales and the earlier ones are generally small but not necessarily negligible. A recent review of temperature scale differences by Hust [1969] treats the subject in detail, including present as well as older frequently used temperature scales. Since the bulk of existing thermocouple tables are based on the superseded IPTS-48, the temperature differences between the IPTS-68 and the IPTS-48 are tabulated in table 1.2.3 for convenience. It is noted that below 0 $^\circ\text{C}$ the deviations tend to be oscillatory with a maximum deviation of 34 mK at -70°C . The deviations become somewhat more systematic above 0 $^\circ\text{C}$, with a value of 150 mK at 600 $^\circ\text{C}$. Above 600 $^\circ\text{C}$ the deviations are nearly linear with temperature. At 2000 $^\circ\text{C}$ the deviation is 3.2 K. For further details regarding deviations at lower temperatures, the reader is referred to the article by Hust.

Wherever necessary the primary data were corrected to be on the current temperature scales before the curve fitting procedures were begun.

TABLE 1.2.1. *Defining fixed points of the IPTS-68^a*

Equilibrium state	Assigned value of International Practical Temperature	
	T_{68} (K)	t_{68} (°C)
Equilibrium between the solid, liquid and vapor phases of equilibrium hydrogen (triple point of equilibrium hydrogen)	13.81	-259.34
Equilibrium between the liquid and vapor phases of equilibrium hydrogen at a pressure of 33 330.6 N/m ² (25/76 standard atmosphere)	17.042	-256.108
Equilibrium between the liquid and vapor phases of equilibrium hydrogen (boiling point of equilibrium hydrogen)	20.28	-252.87
Equilibrium between the liquid and vapor phases of neon (boiling point of neon)	27.102	-246.048
Equilibrium between the solid, liquid and vapor phases of oxygen (triple point of oxygen)	54.361	-218.789
Equilibrium between the liquid and vapor phases of oxygen (boiling point of oxygen)	90.188	-182.962
Equilibrium between the solid, liquid and vapor phases of water (triple point of water) ^c	273.16	0.01
Equilibrium between the liquid and vapor phases of water (boiling point of water) ^{b, c}	373.15	100
Equilibrium between the solid and liquid phases of zinc (freezing point of zinc)	692.73	419.58
Equilibrium between the solid and liquid phases of silver (freezing point of silver)	1235.08	961.93
Equilibrium between the solid and liquid phases of gold (freezing point of gold)	1337.58	1064.43

^a Except for the triple points and one equilibrium hydrogen point (17.042 K) the assigned values of temperature are for equilibrium states at a pressure $p_0 = 1$ standard atmosphere (101 325 N/m²). In the realization of the fixed points small departures from the assigned temperatures will occur as a result of the differing immersion depths of thermometers or the failure to realize the required pressure exactly. If due allowance is made for these small temperature differences, they will not affect the accuracy of realization of the Scale. The magnitudes of these differences are given in section III of the original article by CIPM [1969].

^b The equilibrium state between the solid and liquid phases of tin (freezing point of tin) has the assigned value of $t_{68} = 231.9681$ °C and may be used as an alternative to the boiling point of water.

^c The water used should have the isotopic composition of ocean water, see section III, 4, of the original article by CIPM [1969].

TABLE 1.2.2. *Secondary reference points of the IPTS-68*

Equilibrium state	International Practical Temperature	
	T_{68} (K)	t_{68} (°C)
Equilibrium between the solid, liquid, and vapor phases of normal hydrogen (triple point of normal hydrogen)	13.956	-259.194
Equilibrium between the liquid and vapor phases of normal hydrogen (boiling point of normal hydrogen)	20.397	-252.753
$\lg \frac{p}{p_0} = A + \frac{B}{T_{68}} + CT_{68} + DT_{68}^2 \quad (23)^a$		
$A = 1.734\,791, \quad B = -44.623\,68\text{K}, \quad C = 0.023\,186\,9\text{K}^{-1}, \quad D = -0.000\,048\,017\text{K}^{-2}$ <p>for the temperature range from 13.956 K to 30 K.</p>		
Equilibrium between the solid, liquid, and vapor phases of neon (triple point of neon)	24.555	-248.595
Equilibrium between the liquid and vapor phases of neon		
$\lg \frac{p}{p_0} = A + \frac{B}{T_{68}} + CT_{68} + DT_{68}^2 \quad (24)$		
$A = 4.611\,52, \quad B = -106.3851\text{K}, \quad C = -0.036\,833\,1\text{K}^{-1}, \quad D = 4.248\,02 \times 10^{-4}\text{K}^{-2}$ <p>for the temperature range from 24.555 K to 40 K.</p>		
Equilibrium between the solid, liquid and vapor phases of nitrogen (triple point of nitrogen)	63.148	-210.002
Equilibrium between the liquid and vapor phases of nitrogen (boiling point of nitrogen)	77.348	-195.802

TABLE 1.2.2. Secondary reference points of the IPTS-68—Continued

Equilibrium state	International Practical Temperature	
	T_{68} (K)	t_{68} (°C)
$\lg \frac{p}{p_0} = A + \frac{B}{T_{68}} + C \lg \frac{T_{68}}{T_0} + DT_{68} + ET_{68}^2 \quad (25)$ $A = 5.893\,139, \quad B = -404.131\,05\text{ K}, \quad C = -2.3749, \quad D = -0.014\,250\,5\text{ K}^{-1},$ $E = 72.5342 \times 10^{-6}\text{ K}^{-2}$ for the temperature range from 63.148 K to 84 K. Equilibrium between the liquid and vapor phases of oxygen		
$\lg \frac{p}{p_0} = A + \frac{B}{T_{68}} + C \lg \frac{T_{68}}{T_0} + DT_{68} + ET_{68}^2 \quad (26)$ $A = 5.961\,546, \quad B = -467.455\,76\text{ K}, \quad C = -1.664\,512, \quad D = -0.013\,213\,01\text{ K}^{-1},$ $E = 50.8041 \times 10^{-6}\text{ K}^{-2}$ for the temperature range from 54.361 K to 94 K. Equilibrium between the solid and vapor phases of carbon dioxide (sublimation point of carbon dioxide)	194.674	-78.476
$T_{68} = \left[194.674 + 12.264 \left(\frac{p}{p_0} - 1 \right) - 9.15 \left(\frac{p}{p_0} - 1 \right)^2 \right] \text{K} \quad (27)$ for the temperature range from 194 K to 195 K. Equilibrium between the solid and liquid phases of mercury (freezing point of mercury) ^b	234.288	-38.862
Equilibrium between ice and air-saturated water (ice point)	273.15	0
Equilibrium between the solid, liquid and vapor phases of phenoxybenzene (diphenyl ether) (triple point of phenoxybenzene)	300.02	26.87
Equilibrium between the solid, liquid and vapor phases of benzoic acid (triple point of benzoic acid)	395.52	122.37
Equilibrium between the solid and liquid phases of indium (freezing point of indium) ^b	429.784	156.634
Equilibrium between the solid and liquid phases of bismuth (freezing point of bismuth) ^b	544.592	271.442
Equilibrium between the solid and liquid phases of cadmium (freezing point of cadmium) ^b	594.258	321.108
Equilibrium between the solid and liquid phases of lead (freezing point of lead) ^b	600.652	327.502
Equilibrium between the liquid and vapor phases of mercury (boiling point of mercury)	629.81	356.66
$t_{68} = \left[356.66 + 55.552 \left(\frac{p}{p_0} - 1 \right) - 23.03 \left(\frac{p}{p_0} - 1 \right)^2 + 14.0 \left(\frac{p}{p_0} - 1 \right)^3 \right] ^\circ \text{C} \quad (28)$ for $p = 90 \times 10^3\text{ N/m}^2$ to $104 \times 10^3\text{ N/m}^2$. Equilibrium between the liquid and vapor phases of sulphur (boiling point of sulphur)	717.824	444.674
$t_{68} = \left[444.674 + 69.010 \left(\frac{p}{p_0} - 1 \right) - 27.48 \left(\frac{p}{p_0} - 1 \right)^2 + 19.14 \left(\frac{p}{p_0} - 1 \right)^3 \right] ^\circ \text{C} \quad (29)$ for $p = 90 \times 10^3\text{ N/m}^2$ to $104 \times 10^3\text{ N/m}^2$. Equilibrium between the solid and liquid phases of the copper-aluminum eutectic	821.38	548.23
Equilibrium between the solid and liquid phases of antimony (freezing point of antimony) ^b	903.89	630.74
Equilibrium between the solid and liquid phases of aluminum (freezing point of aluminum)	933.52	660.37
Equilibrium between the solid and liquid phases of copper (freezing point of copper)	1357.6	1084.5
Equilibrium between the solid and liquid phases of nickel (freezing point of nickel)	1728	1455
Equilibrium between the solid and liquid phases of cobalt (freezing point of cobalt)	1767	1494
Equilibrium between the solid and liquid phases of palladium (freezing point of palladium)	1827	1554
Equilibrium between the solid and liquid phases of platinum (freezing point of platinum)	2045	1772
Equilibrium between the solid and liquid phases of rhodium (freezing point of rhodium)	2236	1963
Equilibrium between the solid and liquid phases of iridium (freezing point of iridium)	2720	2447
Equilibrium between the solid and liquid phases of tungsten (temperature of melting tungsten)	3660	3387

^a Equation numbers refer to those used in CIPM [1969].^b See the original article by CIPM [1969] for the effect of pressure variations on these freezing points.

TABLE 1.2.3. *Approximate differences between IPTS-68 and IPTS-48; values tabulated are $(T_{68}-T_{48})K$*

$t_{68}, ^\circ\text{C}$	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-100	0.022	0.013	0.003	-0.006	-0.013	-0.013	-0.005	0.007	0.012		
-0	0.000	0.006	0.012	0.018	0.024	0.029	0.032	0.034	0.033	0.029	0.022
$t_{68}, ^\circ\text{C}$	0	10	20	30	40	50	60	70	80	90	100
0	0.000	-0.004	-0.007	-0.009	-0.010	-0.010	-0.010	-0.008	-0.006	-0.003	0.000
100	0.000	0.004	0.007	0.012	0.016	0.020	0.025	0.029	0.034	0.038	0.043
200	0.043	0.047	0.051	0.054	0.058	0.061	0.064	0.067	0.069	0.071	0.073
300	0.073	0.074	0.075	0.076	0.077	0.077	0.077	0.077	0.077	0.076	0.076
400	0.076	0.075	0.075	0.075	0.074	0.074	0.074	0.075	0.076	0.077	0.079
500	0.079	0.082	0.085	0.089	0.094	0.100	0.108	0.116	0.126	0.137	0.150
600	0.150	0.165	0.182	0.200	0.23	0.25	0.28	0.31	0.34	0.36	0.39
700	0.39	0.42	0.45	0.47	0.50	0.53	0.56	0.58	0.61	0.64	0.67
800	0.67	0.70	0.72	0.75	0.78	0.81	0.84	0.87	0.89	0.92	0.95
900	0.95	0.98	1.01	1.04	1.07	1.10	1.12	1.15	1.18	1.21	1.24
1000	1.24	1.27	1.30	1.33	1.36	1.39	1.42	1.44			
$t_{68}, ^\circ\text{C}$	0	100	200	300	400	500	600	700	800	900	1000
1000		1.5	1.7	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
2000	3.2	3.5	3.7	4.0	4.2	4.5	4.8	5.0	5.3	5.6	5.9
3000	5.9	6.2	6.5	6.9	7.2	7.5	7.9	8.2	8.6	9.0	9.3

Tabular values of the thermoelectric voltage are given in this Monograph for various single thermoelements versus platinum, Pt-67, which is the designation for the new platinum thermoelectric reference standard that is maintained by the Temperature Section of NBS. It replaces the former standard, Pt-27, which was used from 1922 until 1973. A history of Pt-27 was given by Wichers [1962]. The high purity platinum standard reference material, designated SRM No. 680, that was issued in 1967 by the NBS Office of Standard Reference Materials, NBS Tech. News Bull. [1968a], provides the basis for Pt-67. More specifically, Pt-67 is a selected portion of SRM No. 680 that was set aside to serve as the thermoelectric reference standard.

The material for Pt-67 (SRM No. 680) was prepared at the Sigmund Cohn Corp. by induction melting of high purity platinum sponge in a zirconium silicate crucible, and casting into a platinum-lined water-cooled copper mold. The ingot was worked down and drawn into wire taking the utmost precautions to minimize contamination. This lot of platinum wire received extensive characterization under the direction of the NBS Office of Standard Reference Materials. It was found satisfactory with respect to homogeneity and was subsequently certified for chemical composition. Cooperating with NBS in this extensive analytical program were: Matthey Bishop, Inc.; Sigmund Cohn

Corp.; Engelhard Industries, Inc.; Johnson, Matthey and Co., Ltd.; and RCA Laboratories.

The chemical composition of Pt-67 is given in table 1.2.4, where the data are the recommended values taken from the provisional certificate of analysis for SRM No. 680 that was issued by the NBS—Office of

TABLE 1.2.4. *Chemical composition of platinum, Pt-67*

Element	Concentration in ppm by wt
Copper	0.1
Silver	0.1
Palladium	0.2
Lead	<1
Iron	0.7
Nickel	<1
Gold	<1
Magnesium	<1
Zirconium	<0.1
Rhodium	<0.2
Iridium	<0.01
Oxygen	4

Standard Reference Materials [1967]. The elemental analyses were made by one or more of the following methods: optical emission spectrography, spark source mass spectrography (isotopic dilution), polarography, spectrophotometry, activation analysis, and vacuum fusion.

The temperature coefficient of electrical resistance between 0 and 100 °C is commonly used as an indicator of the quality of platinum used in thermometry. Two specimens from the lot of Pt-67 wire were tested by each of four cooperating laboratories and the values reported for the temperature coefficient of resistance ranged from 0.003926₀ to 0.003927₅ K⁻¹ while the mean of the values reported was 0.003926₉ K⁻¹. Another sensitive measure of both chemical purity and the state of physical perfection is the residual resistance ratio, $RRR = R_{273K}/R_0$. For most pure metals R_{4K} is experimentally the same as the residual value R_0 , which allows the use of a liquid helium determination. Values of RRR as determined by the Cryogenics Division, NBS, Boulder, for five specimens that were taken at equally separated points along the lot of wire ranged from about 3400 to 3700 [Sparks and Hust, 1973]. The mean of these five measurements was about 3500. Specimen preparation prior to these tests consisted of cleaning in aqua regia for 12 minutes at 50 °C, rinsing in distilled water and annealing in air at 600 °C for 1 hour followed by slow cooling to room temperature.

Each of four cooperating laboratories also determined the thermoelectric voltage of two specimens of Pt-67 against the former standard, Pt-27. For a measuring junction temperature of 1200 °C and with the reference junctions at 0 °C, values of -9 and -10 μV were reported. (Pt-67 is thermoelectrically negative with respect to Pt-27.) The value obtained and used by NBS is -9 μV, based upon Pt-27 as it was maintained at NBS since 1950. Measurements at NBS indicated that when the reference junction is at 0 °C the thermoelectric voltage-temperature relationship of Pt-67 versus Pt-27 could be approximated by $E = -7.5 \times 10^{-3} t_{68}$, where E is the thermoelectric voltage in absolute microvolts and t_{68} is the temperature in degrees Celsius (ITS-68). This relationship was found to be valid over the range -195 to 1200 °C to within the estimated limits of experimental uncertainty (about ± 1 μV below 600 °C, increasing to about ± 2 μV at 1200 °C). Sufficient data were not available to substantiate its validity beyond this temperature range; however, data available for other thermometry grade platinum wires support its extrapolation to higher temperatures but not to lower temperatures. The above results were obtained with specimens of Pt-67 wire which had been electrically annealed in air for 10 minutes at 1200 °C and slowly cooled to room temperature.

Cochrane [1970], and Rhys and Taimsalu [1969] have studied the effects of trace impurities on the electrical properties of platinum. Cochrane gives a discussion of the relationship between the chemical composition of Pt-67 and its electrical properties.

1.3. Mathematical Methods

Several basic assumptions concerning desirable methods and objectives were made in fitting the data: we decided to fit the entire temperature range, or at least as large a range as possible, with convergent polynomials, of moderately high order if necessary. This is sometimes referred to as a global fit. An alternative would have been to fit the data with short-range interpolating functions, or spline functions, each appropriate in a relatively narrow temperature range. The latter methods have been most generally used for generating thermocouple tables in the past. The advantages of the methods chosen for this Monograph are that they permit tables, functions, and their derivatives that are smooth over a large range. Tables generated with short range fitting techniques are often discontinuous or wavy. Unfortunately most of the functions used to generate the tables had to have joins: those for types S and R because of the discontinuities in the first derivatives (with respect to t_{68}) of their thermoelectric voltages near the antimony point and at the gold point; those for Types E, K, and T, because the original source data and functions for temperatures lower than 0 °C were different from those above 0 °C. However, at those joins, the upper and lower functions were constrained to have equal values to prevent discontinuities in the voltage. For Types E, K, and T, the first derivatives (Seebeck coefficients) were also constrained to be equal at 0 °C. For Types S and R, the functions were taken directly from the research by Bedford et al. [1972] who left a discontinuity in the first derivatives to reflect the discontinuities in the IPTS-68.

We had been fitting accurate thermodynamic data for some time before this project began, so we had available a general collection of fitting programs and subroutines. It was therefore relatively easy to modify our earlier computer programs to satisfy the special needs of fitting thermocouple data. Our general mathematical methods were described in a paper presented at the Fifth Temperature Symposium [Powell et al., 1972]. Briefly, the methods consist of least squares fitting with orthogonal functions, using Bjorck's [1967] algorithm for the Gram-Schmidt method. Whenever necessary constraints were placed on the voltage or the first derivative to give smooth joins. The proper order of polynomial was selected using the method described in our analysis paper [Powell et al., 1972]. The thermocouple data were neither weighted nor transformed in the fitting procedures, but were occasionally constrained in their values and first derivatives at joins.

Using the altered mathematical methods and computer programs, the procedures for determining the thermocouple functions were relatively straightforward. However, the project computations were quite tedious and lengthy. Most of the functions and tables had to be regenerated several times to comply with the special desires of the various prime users of thermocouple tables and to reflect changes in input data after completion of preliminary or interim tables. This was

especially true for Type S and R thermocouples.

Fortunately, functions were already available for the low temperature portions of the Types E, K and T tables and, near the end of the project, for the Types S and R tables. Wherever necessary the data were converted to the IPTS-68 and referenced to Pt-67 before fitting by polynomial functions.

We made a preliminary fit to all of the high-quality data that were available for each type of material. A fairly small proportion (about 10%) of the data was so poor that it was not used at all. After a rough curve was determined for the total data set, a few of the best thermocouples were selected for refined fitting. The selected thermocouples represented those with values that were nearest the average and smoothest. This selection process also resulted in favoring specific thermocouples whose values were near the adjusted values from NBS Circular 561. If too many, more than two or three, thermocouples are selected for the final fit, then their general differences tend to mask small changes in values that they all share in common. That is, details of specific curve fitting are lost if too many different data sets are taken for input values. Therefore final functions were obtained from one or two of the most representative thermocouples for each type. The determined functions were then used to generate the tabular values presented in this Monograph.

Values for the Types J and K thermocouples represented special problems: the positive thermoelement (iron) of the Type J thermocouple undergoes a phase transformation at 760 °C. Above that temperature the Seebeck coefficient has a different functional dependence on temperature. Therefore a second function was specified for the Type J thermocouple above its transformation temperature. The negative thermoelement (a nickel-manganese-aluminum-silicon alloy) of the Type K thermocouple has a magnetic transformation between 150 and 200 °C. The transformation temperature depends on the composition. Since the composition varies significantly, so does the transformation temperature, varying from 10 to 50 °C about an average value of about 170 °C. The magnetic transformation causes a measurable change in the Seebeck coefficient within about 200 °C of the transformation temperature. This perturbation in Seebeck coefficient, and therefore in total thermal voltage, was treated separately from the overall curve. It was fit with an exponential term.

In addition to the standard thermocouples, the "single legs", or individual thermoelements versus platinum, Pt-67, were also analyzed. In general, we developed functions for the most important thermoelement and for the total thermocouple combination, and then determined the functions for the second thermoelement by subtraction. The noble metal combinations were exceptions: the negative thermoelement of both Type S and Type R thermocouples is already high-purity platinum, though not Pt-67. Hence no thermoelement tables are necessary for those two types. For Type B, data for the individual thermoelements versus platinum were better than the total. We there-

fore fit each thermoelement separately and then obtained the total value by subtraction; symbolically $B = (BP-Pt) - (BN-Pt)$.

The programs that we used to fit the thermocouple data utilized double precision routines, which on our computer allow 12 binary bits for the exponent and signs and 84 bits for the fraction in a floating point number. The tabular values were calculated using single precision routines (12 and 36 bits, respectively) containing 11 significant digits in the input coefficients of the polynomials. Actually 36 binary bits is equivalent to only 10.8 decimal digits so there were occasional round-off errors in converting the digital coefficients to their binary representations. However these occasional round-off errors in the coefficients do not usually propagate errors into the tabular values. For example, we estimated for one of the tables that the probability is less than 0.001 that there is a computational error of one in the last digit of a tabular value.

A majority of the computers in this country, however, use less than 36 binary bits for the fractional part of a single precision floating point number. Many of the smaller on-line or portable units even have as few as 12 bits available for the fractions in floating point arithmetic (this is equivalent to approximately 4 decimal digits). The reduction in number of available bits will of course lead to computational errors, especially for higher order equations and the highest range of temperatures. In some extreme cases, the errors can be greater than 1000 μ V.

Since test calculations on each type of computer would have involved excessive costs, we developed a program that simulated computers with fewer available binary bits. The program changed the appropriate binary bit in the coefficients that was equivalent to the last available bit in machines with 12, 16, 24, or 27 binary bits. The differences between the values calculated with the full 36 bits and those values calculated with an error in an earlier bit were considered to be representative of the errors caused by reduced-bit machines. The differences in methods of rounding-off used in different computer models were not entered into the calculations.

Because the errors are dependent on the temperature range as well as the number of bits used in the machine, the tables of estimated maximum errors are broken into several temperature ranges. The estimated maximum errors that occur when reduced-bit arithmetic is used are given in the second table for each type of thermocouple.

1.4. Material Selection and Application of Data

It is not appropriate to include in this Monograph all of the properties and precautions for each of the thermocouple types. However, much of the more important information is included: history of development and early applications, typical chemical composition, temperature range, atmospheric restrictions, effect of impurities, handling techniques and precautions, standard limits of error, typical deviation plots,

and, of course, the tabular thermoelectric data and generating functions. More detailed information on the properties of each thermoelement can be obtained from the earlier NBS publication, Monograph 40 by Caldwell [1962] and from the ASTM manual, STP 470 edited by Benedict [1970]. The latter book and, more thoroughly, the ASTM STP 492 by Pollock [1971] discuss the background theory of thermocouple systems. The pamphlet by Pollock, though short, is an excellent review of the basic theory of thermoelectric phenomena in metals and alloys.

For the sake of discussion, thermocouple system errors can be divided into four types: environmental, electrical measurement, data reduction, and material variability. Environmentally caused errors (such as excessive radiation or conduction losses, poor reference junction control, slow time response, viscous heating, and nonrepresentative probe location) are especially important, often dominant, in field and factory installations. Errors traceable to electrical instruments and data reduction techniques can usually be well controlled and held to satisfactorily low levels. Only the fourth source of errors, material variability (including calibration errors) are discussed further in this Monograph.

For accurate measurements, the thermoelements should be tested, and probably spot calibrated, by the ultimate user. Tests for homogeneity and other significant properties have been described by Sparks et al. [Monograph 124, 1972] for low temperatures and by Roeser and Lonberger [1958] for high temperatures. These tests are necessary in order to determine the homogeneity characteristics of each type of wire and to determine the most representative wires. Dip tests performed on these materials provide information on short range, medium range, and long range inhomogeneities and compare the materials to existing standards.

No thermal voltage is developed when a loop of homogeneous wire is subjected to a temperature gradient. Similarly, no voltage is generated when two identical wires are joined and the pair of wires is placed in a temperature gradient. The problem in practical thermometry is, however, that the ideal characteristics "homogeneous" and "identical" are not sufficiently well approximated for real thermocouple materials. Actually, a loop of wire placed in a large temperature gradient will usually produce a resultant voltage, sometimes as large as $10\text{ }\mu\text{V}$ for poor materials. If wire from one spool is connected to wire from a different spool of the same nominal composition, their junction is placed in a controlled temperature bath, and the free ends are held at room temperature, then a significant voltage may result; we have observed readings as large as hundreds of microvolts for some base metal alloys. These variable spurious voltages caused by inter-lot variations, inhomogeneities, physical imperfections, and chemical impurities are usually the main source of imprecision and inaccuracy for thermocouple measurements under controlled laboratory conditions.

For descriptive convenience, we have divided inhomogeneities into four categories based on their distance of separation:

(1) *Short-range inhomogeneities* occur in a single wire and are separated by less than five meters, often being within a few centimeters of each other.

(2) *Medium-range inhomogeneities* occur in wires that are from a single spool but are more than five meters apart.

(3) *Long-range inhomogeneities* are found in wires that are from the same general stock but are from different spools.

(4) *Inter-lot variations* in chemical composition, thermal treatment and handling occur in materials produced by different manufacturers, or even in wire produced by the same manufacturer at different times.

The latter two categories of inhomogeneities lead to much larger spurious voltages, especially in cryogenic systems. Well-prepared thermocouple wire can have short-range inhomogeneity effects as low as $0.1\text{ }\mu\text{V}$; alloys from different manufacturers often have inter-lot variations as large as $100\text{ }\mu\text{V}$.

Commercial thermocouple materials are manufactured under quality controls that insure that their thermoelectric voltages will remain within accepted limits of error (usually as specified by ANSI, ASTM, and ISA standards). For example, thermoelectric voltages of base-metal materials may vary by several hundred microvolts from lot to lot without exceeding the recognized limits of error. It is commercially impractical to produce thermocouple materials that are highly uniform from lot to lot.

Because of this commercial variability, an extremely important criteria for accurate thermocouple system design is that all of the thermocouple material of a particular type come from the same lot. Sufficient material should be ordered at the initiation of a project to insure that replacement or additional material will not need to be obtained from other lots or manufacturers, material which, though well within specified error limits, may have significantly different thermoelectric properties from the original.

The letter designations used in this Monograph follow the recommendations of Committee E-20 of the American Society for Testing and Materials. The letter type, e.g., Type T, designates the thermoelectric properties, not the precise chemical composition. Thermocouples of a given type may have variations in composition as long as the resultant thermoelectric properties remain within the established limits of error.

We also follow conventional practice in two other respects: (1) the thermoelement with the more positive absolute thermoelectric voltage of the two thermocouple materials is listed first, e.g., *nickel-chromium* alloy versus *nickel-aluminum* alloy for the Type K thermocouple; and (2) the reference junction is assumed to be at $0\text{ }^{\circ}\text{C}$, the ice point.

The number of significant figures to be carried in reference tables is often a matter of personal preference and is somewhat arbitrary. In this Monograph, the voltage resolution in the main tables is usually

0.01 μ V. That represents more precision than can be obtained with any but the best instrument systems. Especially at high temperatures the quoted precisions can not be easily achieved. A good estimate of the overall inaccuracy of the data for each thermocouple type may be obtained from the standard deviation of the data fit which is given for each thermocouple type. In addition, the industrial recommended limits of error are also quoted. The experimental imprecision below 0 °C is usually 10 to 100 times better than it is at high temperatures.

It should be stressed that **thermocouple material that conforms closely to the high temperature tabular values may not necessarily conform closely at low temperatures (below 0 °C) and vice versa.** If thermocouples are to be used for accurate measurements both above and below 0 °C, then the material must be calibrated in the full temperature range, both above and below 0 °C.

1.5. Acknowledgments

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2. Type S—Platinum—10% Rhodium Alloy Versus Platinum Thermocouples

2.1 Material Specifications and Precautions

This type is often referred to by the nominal chemical composition of its positive thermoelement: *platinum**—10% rhodium. Until this year the composition was somewhat different from the nominal 10 percent rhodium, usually about 9.91 wt%. However, as a result of the recent research by Bedford et al. [1972], the composition of the positive thermoelement has been established to be *platinum*—10.00 \pm 0.05 wt% rhodium. The negative thermoelement is commercially pure platinum. Differences between this commercial material and the platinum thermoelectric reference standard, Pt-67, are described in the next section. Differences between Pt-67 and the earlier standard Pt-27 are summarized in section 1.2. The effect of differences in rhodium content of the positive thermoelement is described later in this section.

The *platinum*—10% rhodium thermocouple was developed and tested by Le Chatelier [1886] almost a century ago. Because of his pioneer work, this type of thermocouple was often referred to as the Le Chatelier couple. In this country the ASTM (E230-68) and ISA (C96.1-64) standards for this thermocouple type have been taken from NBS Circular 561 by Shenker et al. [1955]. The reference tables given in NBS Circular 561 were based on functions given by Roeser and Wensel [1933], as revised to conform with the IPTS-48. In Great Britain, the British Standards Institution (BSI) Table B.S. 1826:1952 for this thermocouple type was based on the research by Barber [1950]. There were considerable differences between the American and British reference tables because of small differences in rhodium content and in different realizations of the temperature scales. Differences between the values given in this Monograph and those given in the previous NBS and BSI tables are shown in the next section.

The early research by Le Chatelier [1886] demonstrated the main advantages of the *platinum*—10% rhodium thermoelement: reproducibility, stability, and usefulness to moderately high temperature. An ASTM manual, STP-470 [1970], and Bennett [1958] have described many of the properties of noble metal thermocouples. For many industrial applications, the Type R or B noble metal thermocouples (described in the next two chapters) have preferable characteristics and are often used instead of Type S systems. However, Type S thermocouples remain the standard for determining temperatures between 630.74 °C and the freezing point of gold (1064.43 °C). The CIPM [1969] article details the temperature scale definition in this range and includes specifications on the limits of the thermocouple voltage. The other fixed point used for determining the constants in the specified quadratic interpolation formula of the thermoelectric voltage is the freezing point of silver, 961.93 °C.

Because of the differences between the British and

American standards for Type S thermocouples, an international program was begun several years ago to rectify the unsatisfactory disagreements and to establish a common set of standard reference tables. The program involved cooperation of three national laboratories: the National Bureau of Standards (USA), the National Physical Laboratory (UK) and the National Research Council (Canada) and of seven manufacturers in Great Britain and the United States. The thoroughly documented results have been published by Bedford et al. [1972].

Their research has confirmed that Type S thermocouples can be used from -50 °C up to the platinum melting point 1767.6 °C (incidentally found to *not* be 1772 °C as listed in the CIPM article). They may be used intermittently at temperatures up to the platinum melting point and continuously up to about 1400 °C. The ultimate useful life of the thermocouple is governed primarily by physical problems of impurity diffusion and grain growth which lead to mechanical failure. The thermocouple is most reliable when used in a clean oxidizing atmosphere (air) but may also be used in inert gaseous atmospheres or in a vacuum for short periods of time. However, as noted in section 4, Type B thermocouples are generally more suitable for these applications. Continued use of Type S thermocouples at high temperatures, above about 1400 °C, leads to excessive grain growth in the platinum thermoelement. Stability of the thermocouple at high temperatures depends primarily upon the quality of the materials used for protecting and insulating the thermocouple. High purity alumina with low iron content appears to be the most suitable material for mechanically supporting and protecting the thermocouple wires.

The ASTM manual STP 470 [1970] indicates the following restrictions on the use of Type S thermocouples at high temperatures: *They should not be used in reducing atmospheres, nor in those containing metallic vapor (such as lead or zinc), nonmetallic vapors (such as arsenic, phosphorus, or sulfur) or easily reduced oxides, unless suitably protected with nonmetallic protecting tubes. They should never be inserted directly into a metallic primary tube.*

The positive thermoelement, *platinum*—10% rhodium, is unstable in a thermal neutron flux because the rhodium converts to palladium. The negative thermoelement, pure platinum, is relatively stable to neutron transmutation. However, fast neutron bombardment will cause physical damage, which will change the thermoelectric voltage unless it is annealed out.

McLaren and Murdock [1972] have described several precautions that must be taken to insure accurate measurements in the intermediate temperature range, including the defined range from 630.74 to 1064.43 °C. They emphasized the importance of annealing techniques.

Both thermoelements of Type S thermocouples are sensitive to impurity contamination. In fact the Type

* Throughout this Monograph in the thermocouple designations an italicized word indicates the primary constituent of an alloy.

R thermocouple described in the next section was developed essentially because of iron contamination effects in some British *platinum*—10% rhodium wires. Cochrane [1970] and Aliotta [1972] have recently given detailed descriptions of the effects of various impurities on the thermoelectric voltages of platinum based thermocouple materials. At present good alloy material typically contains less than 500 atomic ppm of impurities; good pure platinum, less than 100 atomic ppm of impurities. High temperature impurity contamination usually causes negative drifts in calibration, the extent of which will depend on the type and amount of chemical contaminant. Volatilization of rhodium from the positive thermoelement or diffusion of rhodium from the positive thermoelement into the pure platinum negative thermoelement will also cause negative drifts in the thermoelectric output.

At the gold point, 1064.43 °C, the thermoelectric voltage of Type S thermocouples increases by about 340 μV ($\sim 3\%$) per weight percent increase in rhodium content; the Seebeck coefficient increases by about 4 percent per weight percent increase at the same temperature.

The thermoelectric voltages of platinum based thermocouples are sensitive to their heat treatments. In particular, quenching from high temperatures should be avoided. Before annealing, platinum and platinum-rhodium alloy wires should be degreased with solvents such as trichloroethane or trichloroethylene and then may be rinsed with distilled water. After cleaning, they should be annealed by the techniques recommended by Bedford et al. [1972]: Anneal electrically in air at 1450 °C for 30 minutes and then slowly cool them to room temperature. The air should be dust free, of course. After assembly in insulating and protecting tubes, the thermocouple should be reannealed for one hour at 1100 °C or for 30 minutes at 1400 °C and then slowly cooled (about 30 minutes) to room temperature.

The Office of Standard Reference Materials of the National Bureau of Standards has prepared a large lot of reference grade platinum wire approximately 0.5 mm in diameter. The material has been thoroughly characterized chemically and electrically and is available from the National Bureau of Standards as Standard Reference Material—SRM No. 680. A selected portion of that material has been set aside for use as a thermoelectric reference standard by the Temperature Section of the NBS. It is referred to as Pt-67. A description of the chemical composition and electrical properties of Pt-67 is given in section 1.2.

ASTM Standard E230-72 in the Annual Book of ASTM Standards [1972] specifies that the standard limits of error for Type S commercial thermocouples be ± 1.4 °C between 0 and 538 °C and $\pm \frac{1}{4}$ percent between 538 and 1482 °C. Limits of error are not specified for Type S thermocouples below 0 °C. The recommended upper temperature limit for continuous use of protected thermocouples, 1482 °C, applies to AWG 24 (0.5 mm) wire.

2.2. Data Analyses and Comparisons

The fitting functions for Type S thermocouples are taken directly from the original research recently published by Bedford et al. [1972]. Their values for thermoelectric voltages were based on the IPTS-68 and therefore no temperature scale corrections were necessary. They used a high-purity platinum, but not Pt-67, as the negative thermoelement. We made only one modification to their functional expressions: the basic voltage function above 1064 °C is also expressed as a simple power series in this Monograph. For completeness their reduced temperature expression is also included in table 2.3.1.

Bedford et al. [1972] carried out research on twelve meters of wire for each thermoelement from each of four American and two British manufacturers. The National Bureau of Standards and the National Research Council calibrated the thermocouples from -50 °C to the gold freezing point (1064.43 °C); the National Physics Laboratory performed the measurements at higher temperatures. The authors gave a very thorough description of their measurement and analysis techniques.

Bedford et al. [1972] based their fitting functions and tables on a selected lot of wire from one manufacturer, labeled A. As a first step, they fit the values in the defined temperature range 630.74 °C to 1064.43 °C by a quadratic function. Next, all of the data below 630.74 °C was fit with a sixth degree function that was constrained in value at 0 °C and 630.74 °C. The fit had a standard deviation of 0.53 μV for 70 experimental points. The temperature range above 1064.43 °C was split in two: one range was from 1064.43 °C to 1665 °C; the other, from 1665 °C to 1767.6 °C (their measured value for the melting point of platinum; see also Quinn and Chandler [1971]). They used a reduced temperature variable for the fitting above 1064 °C. A cubic function constrained at 1064.43 °C was used for the first upper range; another cubic function constrained at 1665 °C was used for the second range. The first fit had a standard deviation of 1.4 μV for eight points; the second, 2.0 μV for eight points. The maximum difference that they found between any two sets of wires was about 50 μV at 1767 °C.

The values for thermoelectric voltages given in this Monograph were compared to those given in 53 calibrations (dated between 1966 and 1970) from the Temperature Section of the National Bureau of Standards in Gaithersburg. All of the wires were from the *older*, *nominally* 10 percent rhodium material; none were from the newer, precisely 10 percent rhodium material used for the international comparison. Deviations are shown in figure 2.2.1. for five thermocouples representative of the older material. All values were adjusted to the IPTS-68. The systematic trend between the old material and the new tables is obvious. Deviations for thermocouples from six different manufacturers measured by Bedford et al. [1972] (all are the *newer*, accurately 10% rhodium material) are shown in figure 2.2.2. Material A was used by Bedford

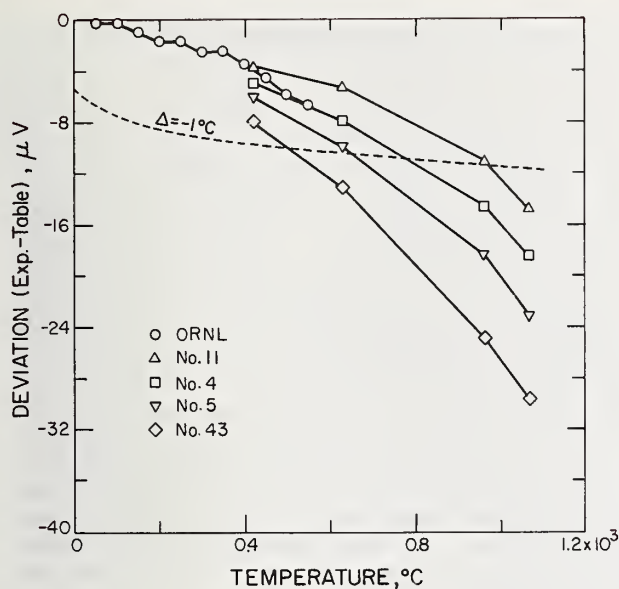


FIGURE 2.2.1. Deviations of thermoelectric voltages of Type S thermocouples—comparison of values given in this Monograph to those for typical thermocouples which conform to the previous Type S standard (NBS Circular 561). Experimental values for thermocouples Nos. 4, 5, 11, 43 and ORNL are from selected calibrations by the Temperature Section (NBS, Gaithersburg). Values from the previous calibrations are adjusted to the IPTS-68. The dashed line indicates a deviation of 1 °C.

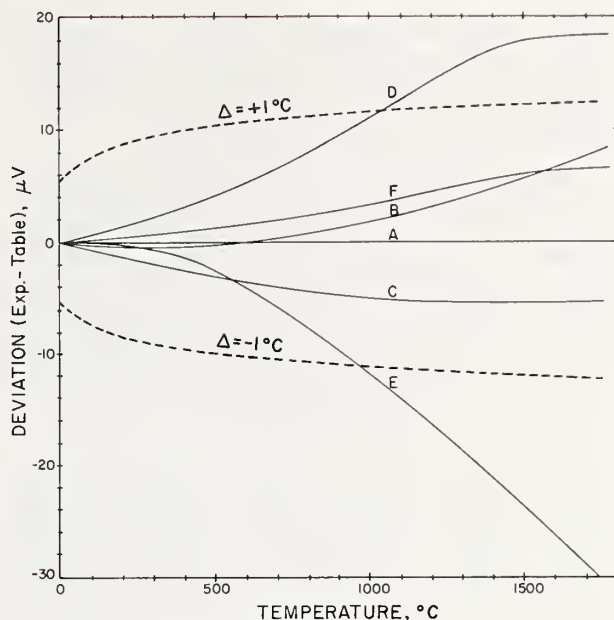


FIGURE 2.2.2. Deviation of thermoelectric voltages of Type S thermocouples—comparison of values given in this Monograph to experimental data by Bedford, et al. [1972]. All values are expressed on the IPTS-68. The dashed lines indicate a deviation of 1 °C.

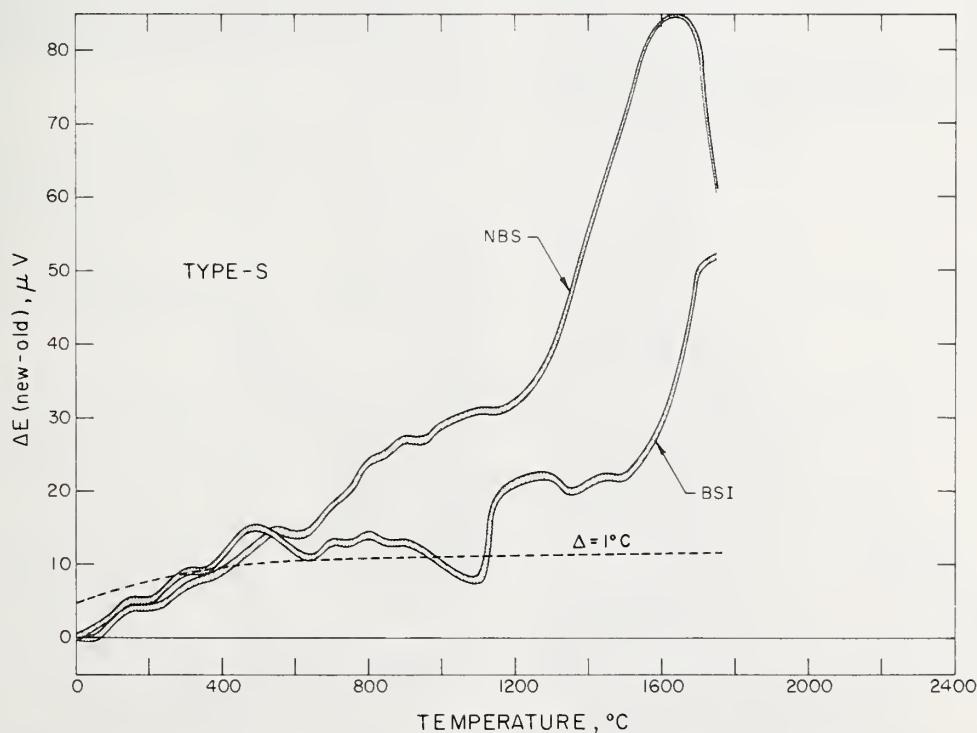


FIGURE 2.2.3. Difference in thermoelectric voltages for Type S thermocouples—comparison of values given in this Monograph to those given in: NBS Circular 561; BSI (B.S. 1826:1952). The width of the shaded curves indicates the round-off uncertainty in the previous tabular values. Values from the previous standards are adjusted to the IPTS-68. The dashed line indicates a deviation of 1 °C.

et al. [1972] for generation of their recommended functions. The negative thermoelement (Material A) was about $6 \mu\text{V}$ positive with respect to Pt-67 at 1064.43°C , which is typical of present day thermocouple-quality (reference grade) platinum.

Deviations between values given in this Monograph and those given by Shenker et al. [1955] in NBS Circular 561 and by the British Standards Institute [1952] are shown in figure 2.2.3. The earlier values were adjusted to the IPTS-68. The deviation curves indicate differences caused by variation in material composition, experimental error, and fitting techniques. The width of the curve represents the round-off uncertainty ($1 \mu\text{V}$) in the tabular values quoted in the two previous standard tables.

The reference tables for Type S thermocouples given in this Monograph were derived by Bedford et al. [1972] in such a way that the thermoelectric voltage, E , is a continuous function of temperature (t_{68}) over the whole range. However, there are discontinuities in some derivatives at some of the joins in tempera-

ture ranges. These discontinuities can be clearly seen in figure 2.3.3. Bedford et al. [1972] have explained why the discontinuities are necessary: the Seebeck coefficient is discontinuous at 630.74°C , the lower limit of the defined temperature range. These discontinuities are implicit in the definition of the IPTS-68, see CIPM [1969]. At 630.74°C the standard interpolating instrument is changed from a platinum resistance thermometer to a Type S thermocouple. Above the gold freezing point, 1064.43°C , an optical pyrometer is most commonly used to measure temperatures. It would be fortunate if the three methods actually joined smoothly at the two temperatures 630.74 and 1064.43°C . However, they do not, and the discontinuities in derivatives are reflected in the values for Type S and Type R thermocouples. At 630.74°C the discontinuities in Seebeck coefficients are 0.18 percent for both Type S and R thermocouples (higher values above 630.74°C). At 1064.43°C the discontinuities in Seebeck coefficients were so small, less than 0.1 percent, that they could be removed mathematically.

2.3. Reference Functions and Tables for Type S Thermocouples

The coefficients for the four sets of equations for the thermoelectric voltage of Type S thermocouples are given in table 2.3.1. The reduced temperature expressions generated by Bedford et al. [1972] are included. The errors caused by using reduced bit arithmetic for calculating values of the functions are given in table 2.3.4.

The primary reference values for Type S thermocouples are given in table 2.3.2. Values at selected fixed

points are given in table 2.3.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 2.3.1, 2.3.2, and 2.3.3, respectively. Discontinuities in the second derivative are apparent in figure 2.3.3. As discussed in the previous section, these discontinuities result from equations for different temperature regions being joined without constraints on their derivatives.

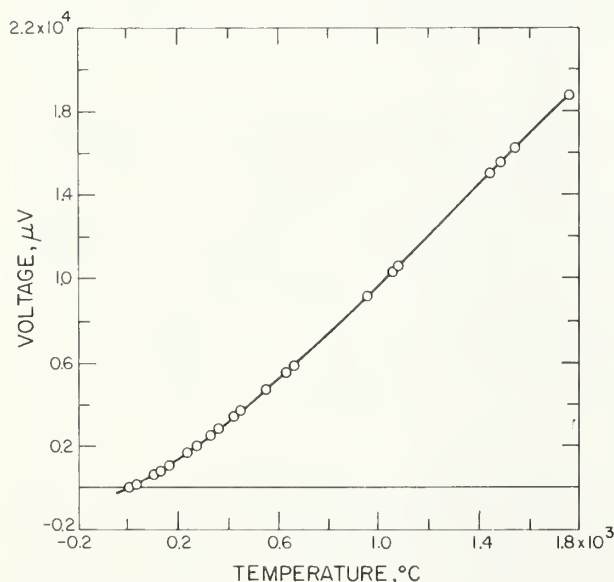


FIGURE 2.3.1. Thermoelectric voltage for Type S thermocouples. The circles indicate values at various thermometric fixed points on the IPTS-68.

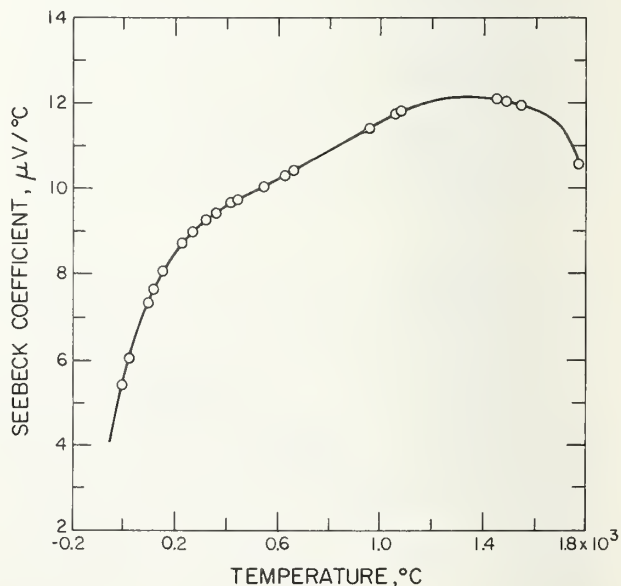


FIGURE 2.3.2. Seebeck coefficient for Type S thermocouples. The circles indicate values at various thermometric fixed points on the IPTS-68.

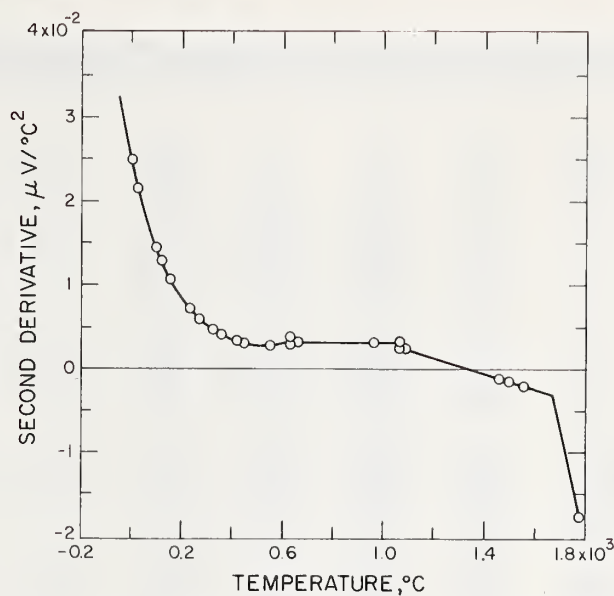


FIGURE 2.3.3. *Second derivative of thermoelectric voltage for Type S thermocouples.*
The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 2.3.1. *Power series expansion for the thermoelectric voltage of Type S thermocouples*

Temperature range	Degree	Coefficients	Term
-50 to 630.74 °C	6	5.3995782346 ...	T
		$1.2519770000 \times 10^{-2}$	T^2
		$-2.2448217997 \times 10^{-5}$	T^3
		$2.8452164949 \times 10^{-8}$	T^4
		$-2.2440584544 \times 10^{-11}$	T^5
		$8.5054166936 \times 10^{-15}$	T^6
630.74 to 1064.43 °C	2	$-2.9824481615 \times 10^2$	...
		8.2375528221 ...	T^1
		$1.6453909942 \times 10^{-3}$	T^2
1064.43 to 1665 °C	3	1.2766292175×10^3	...
		3.4970908041 ...	T^1
		$6.3824648666 \times 10^{-3}$	T^2
		$-1.5722424599 \times 10^{-6}$	T^3
1665 to 1767.6 °C	3	9.7846655361×10^4	...
		$-1.7050295632 \times 10^2$	T^1
		$1.1088699768 \times 10^{-1}$	T^2
		$-2.2494070849 \times 10^{-5}$	T^3
1064.43 to 1665 °C $T^* = \frac{T-1365}{300}$	3	1.3943438677×10^4	...
		3.6398686553×10^3	T^{*1}
		-5.0281206140 ...	T^{*2}
		$-4.2450546418 \times 10^1$	T^{*3}
1665 to 1767.6 °C $T^* = \frac{T-1715}{50}$	3	1.8113083153×10^4	...
		5.6795375480×10^2	T^{*1}
		$-1.2112492121 \times 10^1$	T^{*2}
		-2.8117588563 ...	T^{*3}

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
				-40	-194.44	4.283	31.00	-20	-102.80	4.871	27.87
				-39	-190.14	4.314	30.84	-19	-97.91	4.899	27.73
				-38	-185.81	4.344	30.68	-18	-93.00	4.926	27.58
				-37	-181.45	4.375	30.51	-17	-88.06	4.954	27.43
				-36	-177.06	4.405	30.35	-16	-83.09	4.981	27.28
				-35	-172.64	4.436	30.19	-15	-78.10	5.008	27.14
				-34	-168.19	4.466	30.03	-14	-73.08	5.036	26.99
				-33	-163.71	4.496	29.87	-13	-68.03	5.062	26.85
				-32	-159.20	4.526	29.71	-12	-62.95	5.089	26.71
				-31	-154.66	4.555	29.56	-11	-57.85	5.116	26.56
-50	-235.69	3.964	32.69	-30	-150.09	4.585	29.40	-10	-52.72	5.142	26.42
-49	-231.71	3.997	32.51	-29	-145.49	4.614	29.24	-9	-47.57	5.169	26.28
-48	-227.69	4.029	32.34	-28	-140.86	4.643	29.09	-8	-42.38	5.195	26.14
-47	-223.65	4.062	32.17	-27	-136.20	4.672	28.93	-7	-37.18	5.221	26.00
-46	-219.57	4.094	32.00	-26	-131.52	4.701	28.78	-6	-31.94	5.247	25.86
-45	-215.46	4.126	31.83	-25	-126.80	4.730	28.63	-5	-26.68	5.273	25.72
-44	-211.32	4.157	31.67	-24	-122.06	4.758	28.48	-4	-21.40	5.298	25.58
-43	-207.15	4.189	31.50	-23	-117.29	4.787	28.32	-3	-16.09	5.324	25.45
-42	-202.94	4.220	31.33	-22	-112.49	4.815	28.17	-2	-10.75	5.349	25.31
-41	-198.71	4.252	31.17	-21	-107.66	4.843	28.02	-1	-5.39	5.374	25.17
-40	-194.44	4.283	31.00	-20	-102.80	4.871	27.87	0	0.00	5.400	25.04

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.00	5.400	25.04	60	364.55	6.683	18.09	120	794.81	7.609	13.07
1	5.41	5.425	24.91	61	371.24	6.701	18.00	121	802.43	7.622	13.00
2	10.85	5.449	24.77	62	377.95	6.719	17.90	122	810.05	7.635	12.93
3	16.31	5.474	24.64	63	384.68	6.737	17.80	123	817.70	7.648	12.86
4	21.80	5.499	24.51	64	391.42	6.754	17.70	124	825.35	7.661	12.79
5	27.31	5.523	24.37	65	398.19	6.772	17.61	125	833.02	7.674	12.72
6	32.84	5.547	24.24	66	404.97	6.789	17.51	126	840.70	7.686	12.66
7	38.40	5.572	24.11	67	411.77	6.807	17.42	127	848.39	7.699	12.59
8	43.99	5.596	23.98	68	418.58	6.824	17.32	128	856.10	7.712	12.52
9	49.59	5.620	23.85	69	425.41	6.842	17.23	129	863.81	7.724	12.45
10	55.23	5.643	23.73	70	432.26	6.859	17.14	130	871.54	7.736	12.39
11	60.88	5.667	23.60	71	439.13	6.876	17.04	131	879.29	7.749	12.32
12	66.56	5.691	23.47	72	446.02	6.893	16.95	132	887.04	7.761	12.25
13	72.26	5.714	23.35	73	452.92	6.910	16.86	133	894.81	7.773	12.19
14	77.99	5.737	23.22	74	459.84	6.927	16.77	134	902.59	7.786	12.12
15	83.74	5.760	23.09	75	466.77	6.943	16.68	135	910.38	7.798	12.06
16	89.51	5.783	22.97	76	473.72	6.960	16.59	136	918.18	7.810	12.00
17	95.30	5.806	22.85	77	480.69	6.976	16.50	137	926.00	7.822	11.93
18	101.12	5.829	22.72	78	487.67	6.993	16.41	138	933.83	7.833	11.87
19	106.96	5.852	22.60	79	494.68	7.009	16.32	139	941.67	7.845	11.80
20	112.82	5.874	22.48	80	501.69	7.026	16.23	140	949.52	7.857	11.74
21	118.71	5.897	22.36	81	508.73	7.042	16.14	141	957.38	7.869	11.68
22	124.62	5.919	22.24	82	515.78	7.058	16.05	142	965.26	7.880	11.62
23	130.55	5.941	22.12	83	522.84	7.074	15.97	143	973.14	7.892	11.56
24	136.50	5.963	22.00	84	529.92	7.090	15.88	144	981.04	7.904	11.49
25	142.47	5.985	21.88	85	537.02	7.106	15.80	145	988.95	7.915	11.43
26	148.47	6.007	21.76	86	544.14	7.121	15.71	146	996.87	7.926	11.37
27	154.49	6.029	21.64	87	551.27	7.137	15.62	147	1004.80	7.938	11.31
28	160.53	6.050	21.53	88	558.41	7.153	15.54	148	1012.75	7.949	11.25
29	166.59	6.072	21.41	89	565.57	7.168	15.46	149	1020.70	7.960	11.19
30	172.67	6.093	21.29	90	572.75	7.184	15.37	150	1028.67	7.971	11.13
31	178.78	6.114	21.18	91	579.94	7.199	15.29	151	1036.64	7.983	11.07
32	184.90	6.135	21.06	92	587.14	7.214	15.21	152	1044.63	7.994	11.02
33	191.05	6.157	20.95	93	594.37	7.229	15.12	153	1052.63	8.005	10.96
34	197.21	6.177	20.84	94	601.60	7.244	15.04	154	1060.64	8.015	10.90
35	203.40	6.198	20.72	95	608.85	7.259	14.96	155	1068.66	8.026	10.84
36	209.61	6.219	20.61	96	616.12	7.274	14.88	156	1076.69	8.037	10.78
37	215.84	6.239	20.50	97	623.40	7.289	14.80	157	1084.73	8.048	10.73
38	222.09	6.260	20.39	98	630.70	7.304	14.72	158	1092.79	8.059	10.67
39	228.36	6.280	20.28	99	638.01	7.319	14.64	159	1100.85	8.069	10.61
40	234.65	6.300	20.17	100	645.34	7.333	14.56	160	1108.93	8.080	10.56
41	240.96	6.321	20.06	101	652.68	7.348	14.48	161	1117.01	8.090	10.50
42	247.29	6.341	19.95	102	660.03	7.362	14.40	162	1125.11	8.101	10.45
43	253.64	6.360	19.84	103	667.40	7.377	14.33	163	1133.21	8.111	10.39
44	260.01	6.380	19.74	104	674.79	7.391	14.25	164	1141.33	8.122	10.34
45	266.40	6.400	19.63	105	682.18	7.405	14.17	165	1149.46	8.132	10.28
46	272.81	6.419	19.52	106	689.60	7.419	14.10	166	1157.59	8.142	10.23
47	279.24	6.439	19.42	107	697.02	7.433	14.02	167	1165.74	8.152	10.18
48	285.69	6.458	19.31	108	704.46	7.447	13.94	168	1173.90	8.163	10.12
49	292.16	6.478	19.21	109	711.92	7.461	13.87	169	1182.07	8.173	10.07
50	298.64	6.497	19.10	110	719.38	7.475	13.79	170	1190.24	8.183	10.02
51	305.15	6.516	19.00	111	726.87	7.489	13.72	171	1198.43	8.193	9.97
52	311.67	6.535	18.90	112	734.36	7.502	13.65	172	1206.63	8.203	9.91
53	318.22	6.554	18.80	113	741.87	7.516	13.57	173	1214.84	8.213	9.86
54	324.78	6.572	18.69	114	749.39	7.530	13.50	174	1223.05	8.222	9.81
55	331.36	6.591	18.59	115	756.93	7.543	13.43	175	1231.28	8.232	9.76
56	337.96	6.610	18.49	116	764.48	7.556	13.36	176	1239.52	8.242	9.71
57	344.58	6.628	18.39	117	772.04	7.570	13.28	177	1247.77	8.252	9.66
58	351.22	6.646	18.29	118	779.62	7.583	13.21	178	1256.02	8.261	9.61
59	357.88	6.665	18.19	119	787.21	7.596	13.14	179	1264.29	8.271	9.56
60	364.55	6.683	18.09	120	794.81	7.609	13.07	180	1272.56	8.280	9.51

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	1272.56	8.280	9.51	240	1784.87	8.772	7.02	300	2322.68	9.138	5.31
181	1280.85	8.290	9.46	241	1793.64	8.779	6.99	301	2331.82	9.144	5.29
182	1289.14	8.299	9.41	242	1802.42	8.786	6.95	302	2340.97	9.149	5.26
183	1297.45	8.309	9.36	243	1811.21	8.793	6.92	303	2350.12	9.154	5.24
184	1305.76	8.318	9.31	244	1820.01	8.799	6.89	304	2359.28	9.159	5.22
185	1314.08	8.327	9.26	245	1828.81	8.806	6.85	305	2368.44	9.165	5.19
186	1322.41	8.336	9.22	246	1837.62	8.813	6.82	306	2377.61	9.170	5.17
187	1330.76	8.346	9.17	247	1846.44	8.820	6.79	307	2386.78	9.175	5.15
188	1339.11	8.355	9.12	248	1855.26	8.827	6.76	308	2395.96	9.180	5.13
189	1347.47	8.364	9.07	249	1864.09	8.834	6.72	309	2405.14	9.185	5.10
190	1355.83	8.373	9.03	250	1872.93	8.840	6.69	310	2414.33	9.190	5.08
191	1364.21	8.382	8.98	251	1881.77	8.847	6.66	311	2423.52	9.195	5.06
192	1372.60	8.391	8.94	252	1890.62	8.854	6.63	312	2432.72	9.200	5.04
193	1380.99	8.400	8.89	253	1899.48	8.860	6.59	313	2441.92	9.206	5.02
194	1389.40	8.409	8.84	254	1908.34	8.867	6.56	314	2451.13	9.211	5.00
195	1397.81	8.418	8.80	255	1917.21	8.873	6.53	315	2460.34	9.216	4.97
196	1406.23	8.426	8.75	256	1926.09	8.880	6.50	316	2469.56	9.220	4.95
197	1414.66	8.435	8.71	257	1934.97	8.886	6.47	317	2478.78	9.225	4.93
198	1423.10	8.444	8.66	258	1943.86	8.893	6.44	318	2488.01	9.230	4.91
199	1431.55	8.452	8.62	259	1952.76	8.899	6.41	319	2497.25	9.235	4.89
200	1440.01	8.461	8.58	260	1961.66	8.906	6.38	320	2506.48	9.240	4.87
201	1448.47	8.470	8.53	261	1970.57	8.912	6.35	321	2515.73	9.245	4.85
202	1456.95	8.478	8.49	262	1979.49	8.918	6.32	322	2524.97	9.250	4.83
203	1465.43	8.487	8.45	263	1988.41	8.925	6.29	323	2534.23	9.255	4.81
204	1473.92	8.495	8.40	264	1997.33	8.931	6.26	324	2543.48	9.259	4.79
205	1482.42	8.503	8.36	265	2006.27	8.937	6.23	325	2552.74	9.264	4.77
206	1490.93	8.512	8.32	266	2015.21	8.943	6.20	326	2562.01	9.269	4.75
207	1499.44	8.520	8.28	267	2024.15	8.949	6.17	327	2571.28	9.274	4.73
208	1507.97	8.528	8.23	268	2033.11	8.956	6.14	328	2580.56	9.278	4.71
209	1516.50	8.536	8.19	269	2042.07	8.962	6.11	329	2589.84	9.283	4.69
210	1525.04	8.545	8.15	270	2051.03	8.968	6.09	330	2599.12	9.288	4.67
211	1533.59	8.553	8.11	271	2060.00	8.974	6.06	331	2608.41	9.292	4.65
212	1542.14	8.561	8.07	272	2068.98	8.980	6.03	332	2617.71	9.297	4.63
213	1550.71	8.569	8.03	273	2077.96	8.986	6.00	333	2627.01	9.302	4.61
214	1559.28	8.577	7.99	274	2086.95	8.992	5.97	334	2636.31	9.306	4.59
215	1567.86	8.585	7.95	275	2095.95	8.998	5.95	335	2645.62	9.311	4.58
216	1576.45	8.593	7.91	276	2104.95	9.004	5.92	336	2654.93	9.315	4.56
217	1585.05	8.601	7.87	277	2113.95	9.010	5.89	337	2664.25	9.320	4.54
218	1593.65	8.609	7.83	278	2122.97	9.016	5.86	338	2673.58	9.325	4.52
219	1602.27	8.616	7.79	279	2131.98	9.021	5.84	339	2682.90	9.329	4.50
220	1610.89	8.624	7.75	280	2141.01	9.027	5.81	340	2692.23	9.334	4.48
221	1619.51	8.632	7.71	281	2150.04	9.033	5.78	341	2701.57	9.338	4.47
222	1628.15	8.640	7.67	282	2159.08	9.039	5.76	342	2710.91	9.343	4.45
223	1636.79	8.647	7.64	283	2168.12	9.045	5.73	343	2720.25	9.347	4.43
224	1645.44	8.655	7.60	284	2177.16	9.050	5.71	344	2729.60	9.351	4.41
225	1654.10	8.662	7.56	285	2186.22	9.056	5.68	345	2738.96	9.356	4.39
226	1662.77	8.670	7.52	286	2195.28	9.062	5.65	346	2748.31	9.360	4.38
227	1671.44	8.677	7.49	287	2204.34	9.067	5.63	347	2757.68	9.365	4.36
228	1680.12	8.685	7.45	288	2213.41	9.073	5.60	348	2767.04	9.369	4.34
229	1688.81	8.692	7.41	289	2222.49	9.079	5.58	349	2776.41	9.373	4.33
230	1697.51	8.700	7.38	290	2231.57	9.084	5.55	350	2785.79	9.378	4.31
231	1706.21	8.707	7.34	291	2240.66	9.090	5.53	351	2795.17	9.382	4.29
232	1714.92	8.714	7.30	292	2249.75	9.095	5.50	352	2804.55	9.386	4.28
233	1723.64	8.722	7.27	293	2258.85	9.101	5.48	353	2813.94	9.390	4.26
234	1732.37	8.729	7.23	294	2267.95	9.106	5.45	354	2823.33	9.395	4.24
235	1741.10	8.736	7.20	295	2277.06	9.112	5.43	355	2832.73	9.399	4.23
236	1749.84	8.743	7.16	296	2286.17	9.117	5.41	356	2842.13	9.403	4.21
237	1758.58	8.750	7.13	297	2295.29	9.122	5.38	357	2851.54	9.407	4.19
238	1767.34	8.758	7.09	298	2304.42	9.128	5.36	358	2860.95	9.411	4.18
239	1776.10	8.765	7.06	299	2313.55	9.133	5.33	359	2870.36	9.416	4.16
240	1784.87	8.772	7.02	300	2322.68	9.138	5.31	360	2879.78	9.420	4.15

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	2879.78	9.420	4.15	420	3451.92	9.644	3.39	480	4036.35	9.833	2.96
361	2889.20	9.424	4.13	421	3461.56	9.647	3.38	481	4046.18	9.836	2.96
362	2898.63	9.428	4.11	422	3471.21	9.651	3.37	482	4056.02	9.839	2.95
363	2908.06	9.432	4.10	423	3480.87	9.654	3.36	483	4065.86	9.842	2.95
364	2917.49	9.436	4.08	424	3490.52	9.657	3.35	484	4075.70	9.845	2.95
365	2926.93	9.440	4.07	425	3500.18	9.661	3.34	485	4085.55	9.848	2.94
366	2936.37	9.444	4.05	426	3509.84	9.664	3.33	486	4095.40	9.851	2.94
367	2945.82	9.448	4.04	427	3519.51	9.667	3.32	487	4105.25	9.853	2.94
368	2955.27	9.452	4.02	428	3529.18	9.671	3.31	488	4115.11	9.856	2.93
369	2964.72	9.456	4.01	429	3538.85	9.674	3.30	489	4124.96	9.859	2.93
370	2974.18	9.460	3.99	430	3548.53	9.677	3.29	490	4134.83	9.862	2.93
371	2983.64	9.464	3.98	431	3558.21	9.681	3.28	491	4144.69	9.865	2.92
372	2993.11	9.468	3.97	432	3567.89	9.684	3.28	492	4154.56	9.868	2.92
373	3002.58	9.472	3.95	433	3577.57	9.687	3.27	493	4164.43	9.871	2.92
374	3012.05	9.476	3.94	434	3587.26	9.690	3.26	494	4174.30	9.874	2.91
375	3021.53	9.480	3.92	435	3596.95	9.694	3.25	495	4184.17	9.877	2.91
376	3031.02	9.484	3.91	436	3606.65	9.697	3.24	496	4194.05	9.880	2.91
377	3040.50	9.488	3.89	437	3616.35	9.700	3.23	497	4203.93	9.883	2.90
378	3049.99	9.492	3.88	438	3626.05	9.703	3.22	498	4213.82	9.886	2.90
379	3059.49	9.496	3.87	439	3635.76	9.707	3.22	499	4223.70	9.888	2.90
380	3068.98	9.500	3.85	440	3645.46	9.710	3.21	500	4233.59	9.891	2.90
381	3078.48	9.504	3.84	441	3655.18	9.713	3.20	501	4243.49	9.894	2.90
382	3087.99	9.507	3.83	442	3664.89	9.716	3.19	502	4253.38	9.897	2.89
383	3097.50	9.511	3.81	443	3674.61	9.719	3.18	503	4263.28	9.900	2.89
384	3107.01	9.515	3.80	444	3684.33	9.723	3.18	504	4273.18	9.903	2.89
385	3116.53	9.519	3.79	445	3694.05	9.726	3.17	505	4283.09	9.906	2.89
386	3126.05	9.523	3.77	446	3703.78	9.729	3.16	506	4292.99	9.909	2.89
387	3135.57	9.526	3.76	447	3713.51	9.732	3.15	507	4302.90	9.912	2.88
388	3145.10	9.530	3.75	448	3723.24	9.735	3.15	508	4312.82	9.914	2.88
389	3154.64	9.534	3.73	449	3732.98	9.738	3.14	509	4322.73	9.917	2.88
390	3164.17	9.538	3.72	450	3742.72	9.742	3.13	510	4332.65	9.920	2.88
391	3173.71	9.541	3.71	451	3752.46	9.745	3.13	511	4342.57	9.923	2.88
392	3183.25	9.545	3.70	452	3762.21	9.748	3.12	512	4352.50	9.926	2.88
393	3192.80	9.549	3.68	453	3771.96	9.751	3.11	513	4362.43	9.929	2.88
394	3202.35	9.552	3.67	454	3781.71	9.754	3.11	514	4372.36	9.932	2.88
395	3211.90	9.556	3.66	455	3791.47	9.757	3.10	515	4382.29	9.935	2.87
396	3221.46	9.560	3.65	456	3801.23	9.760	3.09	516	4392.22	9.937	2.87
397	3231.02	9.563	3.64	457	3810.99	9.763	3.09	517	4402.16	9.940	2.87
398	3240.59	9.567	3.62	458	3820.75	9.766	3.08	518	4412.11	9.943	2.87
399	3250.16	9.571	3.61	459	3830.52	9.769	3.07	519	4422.05	9.946	2.87
400	3259.73	9.574	3.60	460	3840.29	9.773	3.07	520	4432.00	9.949	2.87
401	3269.31	9.578	3.59	461	3850.07	9.776	3.06	521	4441.95	9.952	2.87
402	3278.89	9.581	3.58	462	3859.84	9.779	3.06	522	4451.90	9.955	2.87
403	3288.47	9.585	3.57	463	3869.62	9.782	3.05	523	4461.86	9.958	2.87
404	3298.06	9.588	3.55	464	3879.41	9.785	3.04	524	4471.82	9.960	2.87
405	3307.65	9.592	3.54	465	3889.19	9.788	3.04	525	4481.78	9.963	2.87
406	3317.24	9.596	3.53	466	3898.98	9.791	3.03	526	4491.74	9.966	2.87
407	3326.84	9.599	3.52	467	3908.78	9.794	3.03	527	4501.71	9.969	2.87
408	3336.44	9.603	3.51	468	3918.57	9.797	3.02	528	4511.68	9.972	2.87
409	3346.04	9.606	3.50	469	3928.37	9.800	3.02	529	4521.65	9.975	2.88
410	3355.65	9.610	3.49	470	3938.17	9.803	3.01	530	4531.63	9.978	2.88
411	3365.26	9.613	3.48	471	3947.98	9.806	3.01	531	4541.61	9.981	2.88
412	3374.88	9.617	3.47	472	3957.78	9.809	3.00	532	4551.59	9.983	2.88
413	3384.49	9.620	3.46	473	3967.59	9.812	3.00	533	4561.58	9.986	2.88
414	3394.12	9.623	3.45	474	3977.41	9.815	2.99	534	4571.57	9.989	2.88
415	3403.74	9.627	3.44	475	3987.22	9.818	2.99	535	4581.56	9.992	2.88
416	3413.37	9.630	3.43	476	3997.04	9.821	2.98	536	4591.55	9.995	2.88
417	3423.00	9.634	3.42	477	4006.86	9.824	2.98	537	4601.55	9.998	2.89
418	3432.64	9.637	3.41	478	4016.69	9.827	2.97	538	4611.55	10.001	2.89
419	3442.28	9.641	3.40	479	4026.52	9.830	2.97	539	4621.55	10.004	2.89
420	3451.92	9.644	3.39	480	4036.35	9.833	2.96	540	4631.55	10.007	2.89

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	4631.55	10.007	2.89	600	5237.30	10.189	3.27	660	5855.27	10.409	3.29
541	4641.56	10.009	2.89	601	5247.49	10.192	3.28	661	5865.68	10.413	3.29
542	4651.57	10.012	2.90	602	5257.68	10.195	3.29	662	5876.10	10.416	3.29
543	4661.59	10.015	2.90	603	5267.88	10.199	3.30	663	5886.52	10.419	3.29
544	4671.60	10.018	2.90	604	5278.08	10.202	3.31	664	5896.94	10.423	3.29
545	4681.62	10.021	2.90	605	5288.28	10.205	3.32	665	5907.36	10.426	3.29
546	4691.64	10.024	2.91	606	5298.49	10.208	3.33	666	5917.79	10.429	3.29
547	4701.67	10.027	2.91	607	5308.70	10.212	3.34	667	5928.22	10.433	3.29
548	4711.70	10.030	2.91	608	5318.91	10.215	3.36	668	5938.65	10.436	3.29
549	4721.73	10.033	2.92	609	5329.13	10.219	3.37	669	5949.09	10.439	3.29
550	4731.76	10.036	2.92	610	5339.35	10.222	3.38	670	5959.53	10.442	3.29
551	4741.80	10.039	2.92	611	5349.57	10.225	3.39	671	5969.98	10.446	3.29
552	4751.84	10.041	2.93	612	5359.80	10.229	3.41	672	5980.42	10.449	3.29
553	4761.88	10.044	2.93	613	5370.03	10.232	3.42	673	5990.87	10.452	3.29
554	4771.93	10.047	2.93	614	5380.27	10.236	3.43	674	6001.33	10.456	3.29
555	4781.98	10.050	2.94	615	5390.50	10.239	3.45	675	6011.78	10.459	3.29
556	4792.03	10.053	2.94	616	5400.74	10.242	3.46	676	6022.25	10.462	3.29
557	4802.08	10.056	2.95	617	5410.99	10.246	3.47	677	6032.71	10.465	3.29
558	4812.14	10.059	2.95	618	5421.23	10.249	3.49	678	6043.18	10.469	3.29
559	4822.20	10.062	2.96	619	5431.49	10.253	3.50	679	6053.65	10.472	3.29
560	4832.27	10.065	2.96	620	5441.74	10.256	3.52	680	6064.12	10.475	3.29
561	4842.33	10.068	2.96	621	5452.00	10.260	3.53	681	6074.60	10.479	3.29
562	4852.40	10.071	2.97	622	5462.26	10.263	3.54	682	6085.08	10.482	3.29
563	4862.47	10.074	2.97	623	5472.53	10.267	3.56	683	6095.56	10.485	3.29
564	4872.55	10.077	2.98	624	5482.79	10.271	3.57	684	6106.05	10.488	3.29
565	4882.63	10.080	2.99	625	5493.07	10.274	3.59	685	6116.54	10.492	3.29
566	4892.71	10.083	2.99	626	5503.34	10.278	3.61	686	6127.03	10.495	3.29
567	4902.79	10.086	3.00	627	5513.62	10.281	3.62	687	6137.53	10.498	3.29
568	4912.88	10.089	3.00	628	5523.91	10.285	3.64	688	6148.03	10.502	3.29
569	4922.97	10.092	3.01	629	5534.19	10.289	3.65	689	6158.53	10.505	3.29
570	4933.06	10.095	3.01	630	5544.48	10.292	3.67	690	6169.04	10.508	3.29
571	4943.16	10.098	3.02	631	5554.78	10.314	3.29	691	6179.55	10.511	3.29
572	4953.26	10.101	3.03	632	5565.10	10.317	3.29	692	6190.06	10.515	3.29
573	4963.36	10.104	3.03	633	5575.42	10.321	3.29	693	6200.58	10.518	3.29
574	4973.47	10.107	3.04	634	5585.74	10.324	3.29	694	6211.10	10.521	3.29
575	4983.58	10.110	3.05	635	5596.06	10.327	3.29	695	6221.62	10.525	3.29
576	4993.69	10.113	3.05	636	5606.39	10.330	3.29	696	6232.15	10.528	3.29
577	5003.80	10.116	3.06	637	5616.72	10.334	3.29	697	6242.68	10.531	3.29
578	5013.92	10.119	3.07	638	5627.06	10.337	3.29	698	6253.21	10.535	3.29
579	5024.04	10.122	3.07	639	5637.40	10.340	3.29	699	6263.74	10.538	3.29
580	5034.16	10.125	3.08	640	5647.74	10.344	3.29	700	6274.28	10.541	3.29
581	5044.29	10.128	3.09	641	5658.09	10.347	3.29	701	6284.83	10.544	3.29
582	5054.42	10.131	3.10	642	5668.44	10.350	3.29	702	6295.37	10.548	3.29
583	5064.55	10.135	3.11	643	5678.79	10.354	3.29	703	6305.92	10.551	3.29
584	5074.69	10.138	3.11	644	5689.14	10.357	3.29	704	6316.47	10.554	3.29
585	5084.83	10.141	3.12	645	5699.50	10.360	3.29	705	6327.03	10.558	3.29
586	5094.97	10.144	3.13	646	5709.86	10.363	3.29	706	6337.59	10.561	3.29
587	5105.12	10.147	3.14	647	5720.23	10.367	3.29	707	6348.15	10.564	3.29
588	5115.27	10.150	3.15	648	5730.60	10.370	3.29	708	6358.72	10.567	3.29
589	5125.42	10.153	3.16	649	5740.97	10.373	3.29	709	6369.29	10.571	3.29
590	5135.57	10.157	3.17	650	5751.34	10.377	3.29	710	6379.86	10.574	3.29
591	5145.73	10.160	3.17	651	5761.72	10.380	3.29	711	6390.43	10.577	3.29
592	5155.89	10.163	3.18	652	5772.10	10.383	3.29	712	6401.01	10.581	3.29
593	5166.06	10.166	3.19	653	5782.49	10.386	3.29	713	6411.60	10.584	3.29
594	5176.22	10.169	3.20	654	5792.87	10.390	3.29	714	6422.18	10.587	3.29
595	5186.40	10.172	3.21	655	5803.27	10.393	3.29	715	6432.77	10.590	3.29
596	5196.57	10.176	3.22	656	5813.66	10.396	3.29	716	6443.36	10.594	3.29
597	5206.75	10.179	3.23	657	5824.06	10.400	3.29	717	6453.96	10.597	3.29
598	5216.93	10.182	3.24	658	5834.46	10.403	3.29	718	6464.56	10.600	3.29
599	5227.11	10.185	3.25	659	5844.86	10.406	3.29	719	6475.16	10.604	3.29
600	5237.30	10.189	3.27	660	5855.27	10.409	3.29	720	6485.76	10.607	3.29

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	6485.76	10.607	3.29	780	7128.10	10.804	3.29	840	7782.29	11.002	3.29
721	6496.37	10.610	3.29	781	7138.91	10.808	3.29	841	7793.29	11.005	3.29
722	6506.98	10.613	3.29	782	7149.72	10.811	3.29	842	7804.30	11.008	3.29
723	6517.60	10.617	3.29	783	7160.53	10.814	3.29	843	7815.31	11.012	3.29
724	6528.22	10.620	3.29	784	7171.35	10.818	3.29	844	7826.32	11.015	3.29
725	6538.84	10.623	3.29	785	7182.17	10.821	3.29	845	7837.34	11.018	3.29
726	6549.46	10.627	3.29	786	7192.99	10.824	3.29	846	7848.36	11.022	3.29
727	6560.09	10.630	3.29	787	7203.81	10.827	3.29	847	7859.38	11.025	3.29
728	6570.72	10.633	3.29	788	7214.64	10.831	3.29	848	7870.41	11.028	3.29
729	6581.36	10.637	3.29	789	7225.47	10.834	3.29	849	7881.44	11.031	3.29
730	6592.00	10.640	3.29	790	7236.31	10.837	3.29	850	7892.47	11.035	3.29
731	6602.64	10.643	3.29	791	7247.15	10.841	3.29	851	7903.51	11.038	3.29
732	6613.28	10.646	3.29	792	7257.99	10.844	3.29	852	7914.55	11.041	3.29
733	6623.93	10.650	3.29	793	7268.84	10.847	3.29	853	7925.59	11.045	3.29
734	6634.58	10.653	3.29	794	7279.69	10.850	3.29	854	7936.64	11.048	3.29
735	6645.24	10.656	3.29	795	7290.54	10.854	3.29	855	7947.68	11.051	3.29
736	6655.90	10.660	3.29	796	7301.39	10.857	3.29	856	7958.74	11.054	3.29
737	6666.56	10.663	3.29	797	7312.25	10.860	3.29	857	7969.79	11.058	3.29
738	6677.22	10.666	3.29	798	7323.11	10.864	3.29	858	7980.85	11.061	3.29
739	6687.89	10.669	3.29	799	7333.98	10.867	3.29	859	7991.92	11.064	3.29
740	6698.56	10.673	3.29	800	7344.85	10.870	3.29	860	8002.98	11.068	3.29
741	6709.23	10.676	3.29	801	7355.72	10.873	3.29	861	8014.05	11.071	3.29
742	6719.91	10.679	3.29	802	7366.59	10.877	3.29	862	8025.12	11.074	3.29
743	6730.59	10.683	3.29	803	7377.47	10.880	3.29	863	8036.20	11.077	3.29
744	6741.28	10.686	3.29	804	7388.35	10.883	3.29	864	8047.28	11.081	3.29
745	6751.97	10.689	3.29	805	7399.24	10.887	3.29	865	8058.36	11.084	3.29
746	6762.66	10.692	3.29	806	7410.13	10.890	3.29	866	8069.45	11.087	3.29
747	6773.35	10.696	3.29	807	7421.02	10.893	3.29	867	8080.54	11.091	3.29
748	6784.05	10.699	3.29	808	7431.91	10.897	3.29	868	8091.63	11.094	3.29
749	6794.75	10.702	3.29	809	7442.81	10.900	3.29	869	8102.72	11.097	3.29
750	6805.45	10.706	3.29	810	7453.71	10.903	3.29	870	8113.82	11.101	3.29
751	6816.16	10.709	3.29	811	7464.62	10.906	3.29	871	8124.92	11.104	3.29
752	6826.87	10.712	3.29	812	7475.53	10.910	3.29	872	8136.03	11.107	3.29
753	6837.58	10.716	3.29	813	7486.44	10.913	3.29	873	8147.14	11.110	3.29
754	6848.30	10.719	3.29	814	7497.35	10.916	3.29	874	8158.25	11.114	3.29
755	6859.02	10.722	3.29	815	7508.27	10.920	3.29	875	8169.37	11.117	3.29
756	6869.75	10.725	3.29	816	7519.19	10.923	3.29	876	8180.49	11.120	3.29
757	6880.47	10.729	3.29	817	7530.12	10.926	3.29	877	8191.61	11.124	3.29
758	6891.20	10.732	3.29	818	7541.04	10.929	3.29	878	8202.73	11.127	3.29
759	6901.94	10.735	3.29	819	7551.98	10.933	3.29	879	8213.86	11.130	3.29
760	6912.67	10.739	3.29	820	7562.91	10.936	3.29	880	8224.99	11.133	3.29
761	6923.41	10.742	3.29	821	7573.85	10.939	3.29	881	8236.13	11.137	3.29
762	6934.16	10.745	3.29	822	7584.79	10.943	3.29	882	8247.27	11.140	3.29
763	6944.90	10.748	3.29	823	7595.73	10.946	3.29	883	8258.41	11.143	3.29
764	6955.65	10.752	3.29	824	7606.68	10.949	3.29	884	8269.55	11.147	3.29
765	6966.41	10.755	3.29	825	7617.63	10.952	3.29	885	8280.70	11.150	3.29
766	6977.16	10.758	3.29	826	7628.58	10.956	3.29	886	8291.85	11.153	3.29
767	6987.92	10.762	3.29	827	7639.54	10.959	3.29	887	8303.01	11.156	3.29
768	6998.69	10.765	3.29	828	7650.50	10.962	3.29	888	8314.17	11.160	3.29
769	7009.45	10.768	3.29	829	7661.47	10.966	3.29	889	8325.33	11.163	3.29
770	7020.22	10.771	3.29	830	7672.43	10.969	3.29	890	8336.49	11.166	3.29
771	7031.00	10.775	3.29	831	7683.40	10.972	3.29	891	8347.66	11.170	3.29
772	7041.77	10.778	3.29	832	7694.38	10.975	3.29	892	8358.83	11.173	3.29
773	7052.55	10.781	3.29	833	7705.36	10.979	3.29	893	8370.01	11.176	3.29
774	7063.34	10.785	3.29	834	7716.34	10.982	3.29	894	8381.18	11.180	3.29
775	7074.12	10.788	3.29	835	7727.32	10.985	3.29	895	8392.36	11.183	3.29
776	7084.91	10.791	3.29	836	7738.31	10.989	3.29	896	8403.55	11.186	3.29
777	7095.70	10.794	3.29	837	7749.30	10.992	3.29	897	8414.74	11.189	3.29
778	7106.50	10.798	3.29	838	7760.29	10.995	3.29	898	8425.93	11.193	3.29
779	7117.30	10.801	3.29	839	7771.29	10.999	3.29	899	8437.12	11.196	3.29
780	7128.10	10.804	3.29	840	7782.29	11.002	3.29	900	8448.32	11.199	3.29

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	8448.32	11.199	3.29	960	9126.20	11.397	3.29	1020	9815.92	11.594	3.29
901	8459.52	11.203	3.29	961	9137.60	11.400	3.29	1021	9827.52	11.597	3.29
902	8470.72	11.206	3.29	962	9149.00	11.403	3.29	1022	9839.12	11.601	3.29
903	8481.93	11.209	3.29	963	9160.40	11.407	3.29	1023	9850.72	11.604	3.29
904	8493.14	11.212	3.29	964	9171.81	11.410	3.29	1024	9862.33	11.607	3.29
905	8504.36	11.216	3.29	965	9183.22	11.413	3.29	1025	9873.94	11.611	3.29
906	8515.57	11.219	3.29	966	9194.64	11.416	3.29	1026	9885.55	11.614	3.29
907	8526.79	11.222	3.29	967	9206.06	11.420	3.29	1027	9897.16	11.617	3.29
908	8538.02	11.226	3.29	968	9217.48	11.423	3.29	1028	9908.78	11.620	3.29
909	8549.25	11.229	3.29	969	9228.90	11.426	3.29	1029	9920.40	11.624	3.29
910	8560.48	11.232	3.29	970	9240.33	11.430	3.29	1030	9932.03	11.627	3.29
911	8571.71	11.235	3.29	971	9251.76	11.433	3.29	1031	9943.66	11.630	3.29
912	8582.95	11.239	3.29	972	9263.20	11.436	3.29	1032	9955.29	11.634	3.29
913	8594.19	11.242	3.29	973	9274.63	11.439	3.29	1033	9966.93	11.637	3.29
914	8605.43	11.245	3.29	974	9286.07	11.443	3.29	1034	9978.56	11.640	3.29
915	8616.68	11.249	3.29	975	9297.52	11.446	3.29	1035	9990.21	11.644	3.29
916	8627.93	11.252	3.29	976	9308.97	11.449	3.29	1036	10001.85	11.647	3.29
917	8639.18	11.255	3.29	977	9320.42	11.453	3.29	1037	10013.50	11.650	3.29
918	8650.44	11.258	3.29	978	9331.87	11.456	3.29	1038	10025.15	11.653	3.29
919	8661.70	11.262	3.29	979	9343.33	11.459	3.29	1039	10036.81	11.657	3.29
920	8672.96	11.265	3.29	980	9354.79	11.463	3.29	1040	10048.47	11.660	3.29
921	8684.23	11.268	3.29	981	9366.25	11.466	3.29	1041	10060.13	11.663	3.29
922	8695.50	11.272	3.29	982	9377.72	11.469	3.29	1042	10071.79	11.667	3.29
923	8706.77	11.275	3.29	983	9389.19	11.472	3.29	1043	10083.46	11.670	3.29
924	8718.05	11.278	3.29	984	9400.67	11.476	3.29	1044	10095.13	11.673	3.29
925	8729.33	11.282	3.29	985	9412.14	11.479	3.29	1045	10106.81	11.676	3.29
926	8740.61	11.285	3.29	986	9423.62	11.482	3.29	1046	10118.48	11.680	3.29
927	8751.90	11.288	3.29	987	9435.11	11.486	3.29	1047	10130.17	11.683	3.29
928	8763.19	11.291	3.29	988	9446.60	11.489	3.29	1048	10141.85	11.686	3.29
929	8774.48	11.295	3.29	989	9458.09	11.492	3.29	1049	10153.54	11.690	3.29
930	8785.78	11.298	3.29	990	9469.58	11.495	3.29	1050	10165.23	11.693	3.29
931	8797.08	11.301	3.29	991	9481.08	11.499	3.29	1051	10176.92	11.696	3.29
932	8808.38	11.305	3.29	992	9492.58	11.502	3.29	1052	10188.62	11.699	3.29
933	8819.69	11.308	3.29	993	9504.08	11.505	3.29	1053	10200.32	11.703	3.29
934	8831.00	11.311	3.29	994	9515.59	11.509	3.29	1054	10212.03	11.706	3.29
935	8842.31	11.314	3.29	995	9527.10	11.512	3.29	1055	10223.73	11.709	3.29
936	8853.63	11.318	3.29	996	9538.61	11.515	3.29	1056	10235.45	11.713	3.29
937	8864.94	11.321	3.29	997	9550.13	11.518	3.29	1057	10247.16	11.716	3.29
938	8876.27	11.324	3.29	998	9561.65	11.522	3.29	1058	10258.88	11.719	3.29
939	8887.59	11.328	3.29	999	9573.17	11.525	3.29	1059	10270.60	11.722	3.29
940	8898.92	11.331	3.29	1000	9584.70	11.528	3.29	1060	10282.32	11.726	3.29
941	8910.25	11.334	3.29	1001	9596.23	11.532	3.29	1061	10294.05	11.729	3.29
942	8921.59	11.337	3.29	1002	9607.76	11.535	3.29	1062	10305.78	11.732	3.29
943	8932.93	11.341	3.29	1003	9619.30	11.538	3.29	1063	10317.51	11.736	3.29
944	8944.27	11.344	3.29	1004	9630.84	11.541	3.29	1064	10329.25	11.739	3.29
945	8955.62	11.347	3.29	1005	9642.38	11.545	3.29	1065	10340.99	11.742	2.72
946	8966.97	11.351	3.29	1006	9653.93	11.548	3.29	1066	10352.74	11.745	2.71
947	8978.32	11.354	3.29	1007	9665.48	11.551	3.29	1067	10364.48	11.747	2.70
948	8989.67	11.357	3.29	1008	9677.03	11.555	3.29	1068	10376.23	11.750	2.69
949	9001.03	11.361	3.29	1009	9688.59	11.558	3.29	1069	10387.98	11.753	2.68
950	9012.40	11.364	3.29	1010	9700.15	11.561	3.29	1070	10399.74	11.755	2.67
951	9023.76	11.367	3.29	1011	9711.71	11.565	3.29	1071	10411.49	11.758	2.66
952	9035.13	11.370	3.29	1012	9723.28	11.568	3.29	1072	10423.25	11.761	2.65
953	9046.50	11.374	3.29	1013	9734.85	11.571	3.29	1073	10435.01	11.763	2.64
954	9057.88	11.377	3.29	1014	9746.42	11.574	3.29	1074	10446.78	11.766	2.63
955	9069.26	11.380	3.29	1015	9757.99	11.578	3.29	1075	10458.55	11.769	2.62
956	9080.64	11.384	3.29	1016	9769.57	11.581	3.29	1076	10470.32	11.771	2.61
957	9092.02	11.387	3.29	1017	9781.16	11.584	3.29	1077	10482.09	11.774	2.61
958	9103.41	11.390	3.29	1018	9792.74	11.588	3.29	1078	10493.86	11.776	2.60
959	9114.80	11.393	3.29	1019	9804.33	11.591	3.29	1079	10505.64	11.779	2.59
960	9126.20	11.397	3.29	1020	9815.92	11.594	3.29	1080	10517.42	11.782	2.58

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1080	10517.42	11.782	2.58	1140	11228.62	11.919	2.01	1200	11947.05	12.023	1.44
1081	10529.20	11.784	2.57	1141	11240.54	11.921	2.00	1201	11959.08	12.024	1.44
1082	10540.99	11.787	2.56	1142	11252.46	11.923	1.99	1202	11971.10	12.026	1.43
1083	10552.78	11.789	2.55	1143	11264.38	11.925	1.98	1203	11983.13	12.027	1.42
1084	10564.57	11.792	2.54	1144	11276.31	11.927	1.97	1204	11995.16	12.029	1.41
1085	10576.36	11.794	2.53	1145	11288.24	11.929	1.96	1205	12007.19	12.030	1.40
1086	10588.16	11.797	2.52	1146	11300.17	11.931	1.95	1206	12019.22	12.031	1.39
1087	10599.96	11.799	2.51	1147	11312.10	11.933	1.94	1207	12031.25	12.033	1.38
1088	10611.76	11.802	2.50	1148	11324.04	11.935	1.94	1208	12043.28	12.034	1.37
1089	10623.56	11.804	2.49	1149	11335.97	11.937	1.93	1209	12055.32	12.036	1.36
1090	10635.37	11.807	2.48	1150	11347.91	11.939	1.92	1210	12067.35	12.037	1.35
1091	10647.17	11.809	2.47	1151	11359.85	11.941	1.91	1211	12079.39	12.038	1.34
1092	10658.98	11.812	2.46	1152	11371.79	11.943	1.90	1212	12091.43	12.040	1.33
1093	10670.80	11.814	2.45	1153	11383.73	11.945	1.89	1213	12103.47	12.041	1.32
1094	10682.61	11.817	2.44	1154	11395.68	11.946	1.88	1214	12115.51	12.042	1.31
1095	10694.43	11.819	2.44	1155	11407.63	11.948	1.87	1215	12127.55	12.044	1.30
1096	10706.25	11.822	2.43	1156	11419.58	11.950	1.86	1216	12139.60	12.045	1.29
1097	10718.07	11.824	2.42	1157	11431.53	11.952	1.85	1217	12151.64	12.046	1.28
1098	10729.90	11.826	2.41	1158	11443.48	11.954	1.84	1218	12163.69	12.047	1.27
1099	10741.73	11.829	2.40	1159	11455.44	11.956	1.83	1219	12175.74	12.049	1.27
1100	10753.56	11.831	2.39	1160	11467.39	11.958	1.82	1220	12187.79	12.050	1.26
1101	10765.39	11.834	2.38	1161	11479.35	11.959	1.81	1221	12199.84	12.051	1.25
1102	10777.22	11.836	2.37	1162	11491.31	11.961	1.80	1222	12211.89	12.052	1.24
1103	10789.06	11.838	2.36	1163	11503.27	11.963	1.79	1223	12223.94	12.054	1.23
1104	10800.90	11.841	2.35	1164	11515.24	11.965	1.78	1224	12236.00	12.055	1.22
1105	10812.74	11.843	2.34	1165	11527.20	11.967	1.77	1225	12248.05	12.056	1.21
1106	10824.59	11.845	2.33	1166	11539.17	11.968	1.77	1226	12260.11	12.057	1.20
1107	10836.43	11.848	2.32	1167	11551.14	11.970	1.76	1227	12272.17	12.058	1.19
1108	10848.28	11.850	2.31	1168	11563.11	11.972	1.75	1228	12284.23	12.060	1.18
1109	10860.13	11.852	2.30	1169	11575.08	11.974	1.74	1229	12296.29	12.061	1.17
1110	10871.99	11.855	2.29	1170	11587.06	11.975	1.73	1230	12308.35	12.062	1.16
1111	10883.84	11.857	2.28	1171	11599.03	11.977	1.72	1231	12320.41	12.063	1.15
1112	10895.70	11.859	2.27	1172	11611.01	11.979	1.71	1232	12332.47	12.064	1.14
1113	10907.56	11.862	2.27	1173	11622.99	11.980	1.70	1233	12344.54	12.065	1.13
1114	10919.42	11.864	2.26	1174	11634.97	11.982	1.69	1234	12356.61	12.067	1.12
1115	10931.29	11.866	2.25	1175	11646.96	11.984	1.68	1235	12368.67	12.068	1.11
1116	10943.16	11.868	2.24	1176	11658.94	11.986	1.67	1236	12380.74	12.069	1.11
1117	10955.03	11.871	2.23	1177	11670.93	11.987	1.66	1237	12392.81	12.070	1.10
1118	10966.90	11.873	2.22	1178	11682.91	11.989	1.65	1238	12404.88	12.071	1.09
1119	10978.77	11.875	2.21	1179	11694.90	11.990	1.64	1239	12416.95	12.072	1.08
1120	10990.65	11.877	2.20	1180	11706.90	11.992	1.63	1240	12429.02	12.073	1.07
1121	11002.53	11.879	2.19	1181	11718.89	11.994	1.62	1241	12441.10	12.074	1.06
1122	11014.41	11.882	2.18	1182	11730.88	11.995	1.61	1242	12453.17	12.075	1.05
1123	11026.29	11.884	2.17	1183	11742.88	11.997	1.61	1243	12465.25	12.076	1.04
1124	11038.17	11.886	2.16	1184	11754.88	11.999	1.60	1244	12477.33	12.077	1.03
1125	11050.06	11.888	2.15	1185	11766.88	12.000	1.59	1245	12489.40	12.078	1.02
1126	11061.95	11.890	2.14	1186	11778.88	12.002	1.58	1246	12501.48	12.079	1.01
1127	11073.84	11.892	2.13	1187	11790.88	12.003	1.57	1247	12513.56	12.080	1.00
1128	11085.73	11.894	2.12	1188	11802.88	12.005	1.56	1248	12525.64	12.081	0.99
1129	11097.63	11.897	2.11	1189	11814.89	12.006	1.55	1249	12537.73	12.082	0.98
1130	11109.53	11.899	2.11	1190	11826.90	12.008	1.54	1250	12549.81	12.083	0.97
1131	11121.43	11.901	2.10	1191	11838.91	12.010	1.53	1251	12561.89	12.084	0.96
1132	11133.33	11.903	2.09	1192	11850.92	12.011	1.52	1252	12573.98	12.085	0.95
1133	11145.23	11.905	2.08	1193	11862.93	12.013	1.51	1253	12586.06	12.086	0.94
1134	11157.14	11.907	2.07	1194	11874.94	12.014	1.50	1254	12598.15	12.087	0.94
1135	11169.05	11.909	2.06	1195	11886.96	12.016	1.49	1255	12610.24	12.088	0.93
1136	11180.96	11.911	2.05	1196	11898.97	12.017	1.48	1256	12622.33	12.089	0.92
1137	11192.87	11.913	2.04	1197	11910.99	12.019	1.47	1257	12634.41	12.090	0.91
1138	11204.78	11.915	2.03	1198	11923.01	12.020	1.46	1258	12646.51	12.091	0.90
1139	11216.70	11.917	2.02	1199	11935.03	12.021	1.45	1259	12658.60	12.092	0.89
1140	11228.62	11.919	2.01	1200	11947.05	12.023	1.44	1260	12670.69	12.093	0.88

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1260	12670.69	12.093	0.88	1320	13397.49	12.128	0.31	1380	14125.41	12.130	-0.25
1261	12682.78	12.093	0.87	1321	13409.62	12.129	0.30	1381	14137.54	12.130	-0.26
1262	12694.88	12.094	0.86	1322	13421.75	12.129	0.29	1382	14149.67	12.130	-0.27
1263	12706.97	12.095	0.85	1323	13433.87	12.129	0.28	1383	14161.80	12.129	-0.28
1264	12719.07	12.096	0.84	1324	13446.00	12.130	0.28	1384	14173.93	12.129	-0.29
1265	12731.16	12.097	0.83	1325	13458.13	12.130	0.27	1385	14186.06	12.129	-0.30
1266	12743.26	12.098	0.82	1326	13470.26	12.130	0.26	1386	14198.19	12.128	-0.31
1267	12755.36	12.099	0.81	1327	13482.39	12.130	0.25	1387	14210.32	12.128	-0.32
1268	12767.46	12.099	0.80	1328	13494.52	12.131	0.24	1388	14222.45	12.128	-0.33
1269	12779.56	12.100	0.79	1329	13506.66	12.131	0.23	1389	14234.57	12.127	-0.34
1270	12791.66	12.101	0.78	1330	13518.79	12.131	0.22	1390	14246.70	12.127	-0.35
1271	12803.76	12.102	0.78	1331	13530.92	12.131	0.21	1391	14258.83	12.127	-0.36
1272	12815.86	12.102	0.77	1332	13543.05	12.131	0.20	1392	14270.96	12.126	-0.37
1273	12827.96	12.103	0.76	1333	13555.18	12.132	0.19	1393	14283.08	12.126	-0.38
1274	12840.07	12.104	0.75	1334	13567.31	12.132	0.18	1394	14295.21	12.126	-0.39
1275	12852.17	12.105	0.74	1335	13579.44	12.132	0.17	1395	14307.33	12.125	-0.39
1276	12864.28	12.105	0.73	1336	13591.58	12.132	0.16	1396	14319.46	12.125	-0.40
1277	12876.38	12.106	0.72	1337	13603.71	12.132	0.15	1397	14331.58	12.124	-0.41
1278	12888.49	12.107	0.71	1338	13615.84	12.132	0.14	1398	14343.71	12.124	-0.42
1279	12900.60	12.108	0.70	1339	13627.97	12.133	0.13	1399	14355.83	12.124	-0.43
1280	12912.70	12.108	0.69	1340	13640.11	12.133	0.12	1400	14367.95	12.123	-0.44
1281	12924.81	12.109	0.68	1341	13652.24	12.133	0.11	1401	14380.08	12.123	-0.45
1282	12936.92	12.110	0.67	1342	13664.37	12.133	0.11	1402	14392.20	12.122	-0.46
1283	12949.03	12.110	0.66	1343	13676.50	12.133	0.10	1403	14404.32	12.122	-0.47
1284	12961.14	12.111	0.65	1344	13688.64	12.133	0.09	1404	14416.44	12.121	-0.48
1285	12973.25	12.112	0.64	1345	13700.77	12.133	0.08	1405	14428.56	12.121	-0.49
1286	12985.37	12.112	0.63	1346	13712.90	12.133	0.07	1406	14440.69	12.120	-0.50
1287	12997.48	12.113	0.62	1347	13725.04	12.133	0.06	1407	14452.81	12.120	-0.51
1288	13009.59	12.114	0.61	1348	13737.17	12.133	0.05	1408	14464.92	12.119	-0.52
1289	13021.71	12.114	0.61	1349	13749.30	12.133	0.04	1409	14477.04	12.119	-0.53
1290	13033.82	12.115	0.60	1350	13761.44	12.134	0.03	1410	14489.16	12.118	-0.54
1291	13045.94	12.115	0.59	1351	13773.57	12.134	0.02	1411	14501.28	12.118	-0.55
1292	13058.05	12.116	0.58	1352	13785.71	12.134	0.01	1412	14513.40	12.117	-0.56
1293	13070.17	12.116	0.57	1353	13797.84	12.134	0.00	1413	14525.52	12.117	-0.56
1294	13082.28	12.117	0.56	1354	13809.97	12.134	-0.01	1414	14537.63	12.116	-0.57
1295	13094.40	12.118	0.55	1355	13822.11	12.134	-0.02	1415	14549.75	12.116	-0.58
1296	13106.52	12.118	0.54	1356	13834.24	12.134	-0.03	1416	14561.86	12.115	-0.59
1297	13118.64	12.119	0.53	1357	13846.37	12.133	-0.04	1417	14573.98	12.114	-0.60
1298	13130.76	12.119	0.52	1358	13858.51	12.133	-0.05	1418	14586.09	12.114	-0.61
1299	13142.88	12.120	0.51	1359	13870.64	12.133	-0.06	1419	14598.20	12.113	-0.62
1300	13155.00	12.120	0.50	1360	13882.77	12.133	-0.06	1420	14610.32	12.112	-0.63
1301	13167.12	12.121	0.49	1361	13894.91	12.133	-0.07	1421	14622.43	12.112	-0.64
1302	13179.24	12.121	0.48	1362	13907.04	12.133	-0.08	1422	14634.54	12.111	-0.65
1303	13191.36	12.122	0.47	1363	13919.17	12.133	-0.09	1423	14646.65	12.111	-0.66
1304	13203.48	12.122	0.46	1364	13931.31	12.133	-0.10	1424	14658.76	12.110	-0.67
1305	13215.60	12.123	0.45	1365	13943.44	12.133	-0.11	1425	14670.87	12.109	-0.68
1306	13227.73	12.123	0.44	1366	13955.57	12.133	-0.12	1426	14682.98	12.109	-0.69
1307	13239.85	12.124	0.44	1367	13967.70	12.133	-0.13	1427	14695.09	12.108	-0.70
1308	13251.97	12.124	0.43	1368	13979.84	12.133	-0.14	1428	14707.20	12.107	-0.71
1309	13264.10	12.124	0.42	1369	13991.97	12.132	-0.15	1429	14719.30	12.106	-0.72
1310	13276.22	12.125	0.41	1370	14004.10	12.132	-0.16	1430	14731.41	12.106	-0.72
1311	13288.35	12.125	0.40	1371	14016.23	12.132	-0.17	1431	14743.51	12.105	-0.73
1312	13300.47	12.126	0.39	1372	14028.37	12.132	-0.18	1432	14755.62	12.104	-0.74
1313	13312.60	12.126	0.38	1373	14040.50	12.132	-0.19	1433	14767.72	12.103	-0.75
1314	13324.72	12.126	0.37	1374	14052.63	12.132	-0.20	1434	14779.83	12.103	-0.76
1315	13336.85	12.127	0.36	1375	14064.76	12.131	-0.21	1435	14791.93	12.102	-0.77
1316	13348.98	12.127	0.35	1376	14076.89	12.131	-0.22	1436	14804.03	12.101	-0.78
1317	13361.10	12.127	0.34	1377	14089.02	12.131	-0.22	1437	14816.13	12.100	-0.79
1318	13373.23	12.128	0.33	1378	14101.15	12.131	-0.23	1438	14828.23	12.100	-0.80
1319	13385.36	12.128	0.32	1379	14113.28	12.130	-0.24	1439	14840.33	12.099	-0.81
1320	13397.49	12.128	0.31	1380	14125.41	12.130	-0.25	1440	14852.43	12.098	-0.82

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1440	14852.43	12.098	-0.82	1500	15576.49	12.032	-1.39	1560	16295.57	11.932	-1.95
1441	14864.53	12.097	-0.83	1501	15588.52	12.030	-1.39	1561	16307.50	11.930	-1.96
1442	14876.62	12.096	-0.84	1502	15600.55	12.029	-1.40	1562	16319.43	11.928	-1.97
1443	14888.72	12.095	-0.85	1503	15612.58	12.028	-1.41	1563	16331.36	11.926	-1.98
1444	14900.81	12.095	-0.86	1504	15624.61	12.026	-1.42	1564	16343.28	11.924	-1.99
1445	14912.91	12.094	-0.87	1505	15636.63	12.025	-1.43	1565	16355.21	11.922	-2.00
1446	14925.00	12.093	-0.88	1506	15648.66	12.023	-1.44	1566	16367.13	11.920	-2.01
1447	14937.09	12.092	-0.89	1507	15660.68	12.022	-1.45	1567	16379.04	11.918	-2.02
1448	14949.19	12.091	-0.89	1508	15672.70	12.020	-1.46	1568	16390.96	11.916	-2.03
1449	14961.28	12.090	-0.90	1509	15684.72	12.019	-1.47	1569	16402.88	11.914	-2.04
1450	14973.37	12.089	-0.91	1510	15696.74	12.018	-1.48	1570	16414.79	11.912	-2.05
1451	14985.45	12.088	-0.92	1511	15708.76	12.016	-1.49	1571	16426.70	11.910	-2.06
1452	14997.54	12.087	-0.93	1512	15720.77	12.015	-1.50	1572	16438.61	11.908	-2.06
1453	15009.63	12.087	-0.94	1513	15732.79	12.013	-1.51	1573	16450.52	11.906	-2.07
1454	15021.72	12.086	-0.95	1514	15744.80	12.012	-1.52	1574	16462.42	11.904	-2.08
1455	15033.80	12.085	-0.96	1515	15756.81	12.010	-1.53	1575	16474.32	11.901	-2.09
1456	15045.88	12.084	-0.97	1516	15768.82	12.008	-1.54	1576	16486.22	11.899	-2.10
1457	15057.97	12.083	-0.98	1517	15780.83	12.007	-1.55	1577	16498.12	11.897	-2.11
1458	15070.05	12.082	-0.99	1518	15792.83	12.005	-1.56	1578	16510.02	11.895	-2.12
1459	15082.13	12.081	-1.00	1519	15804.84	12.004	-1.56	1579	16521.91	11.893	-2.13
1460	15094.21	12.080	-1.01	1520	15816.84	12.002	-1.57	1580	16533.80	11.891	-2.14
1461	15106.29	12.079	-1.02	1521	15828.84	12.001	-1.58	1581	16545.69	11.889	-2.15
1462	15118.37	12.078	-1.03	1522	15840.84	11.999	-1.59	1582	16557.58	11.887	-2.16
1463	15130.45	12.077	-1.04	1523	15852.84	11.997	-1.60	1583	16569.47	11.884	-2.17
1464	15142.52	12.076	-1.05	1524	15864.84	11.996	-1.61	1584	16581.35	11.882	-2.18
1465	15154.60	12.075	-1.06	1525	15876.83	11.994	-1.62	1585	16593.23	11.880	-2.19
1466	15166.67	12.073	-1.06	1526	15888.83	11.993	-1.63	1586	16605.11	11.878	-2.20
1467	15178.74	12.072	-1.07	1527	15900.82	11.991	-1.64	1587	16616.99	11.876	-2.21
1468	15190.82	12.071	-1.08	1528	15912.81	11.989	-1.65	1588	16628.86	11.873	-2.22
1469	15202.89	12.070	-1.09	1529	15924.80	11.988	-1.66	1589	16640.73	11.871	-2.22
1470	15214.96	12.069	-1.10	1530	15936.78	11.986	-1.67	1590	16652.60	11.869	-2.23
1471	15227.03	12.068	-1.11	1531	15948.77	11.984	-1.68	1591	16664.47	11.867	-2.24
1472	15239.09	12.067	-1.12	1532	15960.75	11.983	-1.69	1592	16676.34	11.864	-2.25
1473	15251.16	12.066	-1.13	1533	15972.73	11.981	-1.70	1593	16688.20	11.862	-2.26
1474	15263.22	12.065	-1.14	1534	15984.71	11.979	-1.71	1594	16700.06	11.860	-2.27
1475	15275.29	12.064	-1.15	1535	15996.69	11.978	-1.72	1595	16711.92	11.858	-2.28
1476	15287.35	12.062	-1.16	1536	16008.67	11.976	-1.72	1596	16723.78	11.855	-2.29
1477	15299.41	12.061	-1.17	1537	16020.64	11.974	-1.73	1597	16735.63	11.853	-2.30
1478	15311.47	12.060	-1.18	1538	16032.62	11.972	-1.74	1598	16747.48	11.851	-2.31
1479	15323.53	12.059	-1.19	1539	16044.59	11.971	-1.75	1599	16759.33	11.848	-2.32
1480	15335.59	12.058	-1.20	1540	16056.56	11.969	-1.76	1600	16771.18	11.846	-2.33
1481	15347.65	12.056	-1.21	1541	16068.53	11.967	-1.77	1601	16783.02	11.844	-2.34
1482	15359.70	12.055	-1.22	1542	16080.49	11.965	-1.78	1602	16794.87	11.841	-2.35
1483	15371.76	12.054	-1.22	1543	16092.46	11.964	-1.79	1603	16806.71	11.839	-2.36
1484	15383.81	12.053	-1.23	1544	16104.42	11.962	-1.80	1604	16818.55	11.837	-2.37
1485	15395.86	12.052	-1.24	1545	16116.38	11.960	-1.81	1605	16830.38	11.834	-2.38
1486	15407.92	12.050	-1.25	1546	16128.34	11.958	-1.82	1606	16842.21	11.832	-2.39
1487	15419.97	12.049	-1.26	1547	16140.30	11.956	-1.83	1607	16854.04	11.830	-2.39
1488	15432.01	12.048	-1.27	1548	16152.25	11.954	-1.84	1608	16865.87	11.827	-2.40
1489	15444.06	12.047	-1.28	1549	16164.21	11.953	-1.85	1609	16877.70	11.825	-2.41
1490	15456.11	12.045	-1.29	1550	16176.16	11.951	-1.86	1610	16889.52	11.822	-2.42
1491	15468.15	12.044	-1.30	1551	16188.11	11.949	-1.87	1611	16901.34	11.820	-2.43
1492	15480.19	12.043	-1.31	1552	16200.06	11.947	-1.88	1612	16913.16	11.818	-2.44
1493	15492.24	12.041	-1.32	1553	16212.00	11.945	-1.89	1613	16924.98	11.815	-2.45
1494	15504.28	12.040	-1.33	1554	16223.95	11.943	-1.89	1614	16936.79	11.813	-2.46
1495	15516.32	12.039	-1.34	1555	16235.89	11.941	-1.90	1615	16948.60	11.810	-2.47
1496	15528.35	12.037	-1.35	1556	16247.83	11.939	-1.91	1616	16960.41	11.808	-2.48
1497	15540.39	12.036	-1.36	1557	16259.77	11.938	-1.92	1617	16972.22	11.805	-2.49
1498	15552.43	12.035	-1.37	1558	16271.70	11.936	-1.93	1618	16984.02	11.803	-2.50
1499	15564.46	12.033	-1.38	1559	16283.64	11.934	-1.94	1619	16995.83	11.800	-2.51
1500	15576.49	12.032	-1.39	1560	16295.57	11.932	-1.95	1620	17007.62	11.798	-2.52

TABLE 2.3.2. *Type S thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1620	17007.62	11.798	-2.52	1680	17710.54	11.616	-4.97	1740	18393.68	11.075	-13.06
1621	17019.42	11.795	-2.53	1681	17722.16	11.611	-5.10	1741	18404.75	11.062	-13.20
1622	17031.21	11.793	-2.54	1682	17733.77	11.605	-5.24	1742	18415.80	11.048	-13.33
1623	17043.01	11.790	-2.55	1683	17745.37	11.600	-5.37	1743	18426.85	11.035	-13.47
1624	17054.79	11.788	-2.56	1684	17756.97	11.595	-5.51	1744	18437.87	11.021	-13.60
1625	17066.58	11.785	-2.56	1685	17768.56	11.589	-5.64	1745	18448.89	11.008	-13.74
1626	17078.36	11.782	-2.57	1686	17780.14	11.583	-5.78	1746	18459.89	10.994	-13.87
1627	17090.15	11.780	-2.58	1687	17791.72	11.577	-5.91	1747	18470.88	10.980	-14.01
1628	17101.92	11.777	-2.59	1688	17803.30	11.572	-6.05	1748	18481.85	10.966	-14.14
1629	17113.70	11.775	-2.60	1689	17814.87	11.565	-6.18	1749	18492.81	10.952	-14.28
1630	17125.47	11.772	-2.61	1690	17826.43	11.559	-6.32	1750	18503.75	10.937	-14.41
1631	17137.24	11.769	-2.62	1691	17837.99	11.553	-6.45	1751	18514.68	10.923	-14.55
1632	17149.01	11.767	-2.63	1692	17849.54	11.546	-6.59	1752	18525.60	10.908	-14.68
1633	17160.78	11.764	-2.64	1693	17861.08	11.540	-6.72	1753	18536.50	10.893	-14.82
1634	17172.54	11.762	-2.65	1694	17872.61	11.533	-6.86	1754	18547.38	10.879	-14.95
1635	17184.30	11.759	-2.66	1695	17884.14	11.526	-6.99	1755	18558.25	10.864	-15.09
1636	17196.06	11.756	-2.67	1696	17895.67	11.519	-7.13	1756	18569.11	10.848	-15.22
1637	17207.81	11.754	-2.68	1697	17907.18	11.512	-7.26	1757	18579.95	10.833	-15.36
1638	17219.57	11.751	-2.69	1698	17918.69	11.504	-7.40	1758	18590.78	10.818	-15.49
1639	17231.32	11.748	-2.70	1699	17930.19	11.497	-7.53	1759	18601.59	10.802	-15.63
1640	17243.06	11.745	-2.71	1700	17941.68	11.489	-7.67	1760	18612.38	10.786	-15.76
1641	17254.81	11.743	-2.72	1701	17953.17	11.482	-7.80	1761	18623.16	10.771	-15.90
1642	17266.55	11.740	-2.72	1702	17964.65	11.474	-7.94	1762	18633.92	10.755	-16.03
1643	17278.29	11.737	-2.73	1703	17976.12	11.466	-8.07	1763	18644.67	10.738	-16.17
1644	17290.02	11.735	-2.74	1704	17987.58	11.457	-8.21	1764	18655.40	10.722	-16.30
1645	17301.76	11.732	-2.75	1705	17999.03	11.449	-8.34	1765	18666.11	10.706	-16.44
1646	17313.49	11.729	-2.76	1706	18010.48	11.441	-8.48	1766	18676.81	10.689	-16.57
1647	17325.21	11.726	-2.77	1707	18021.91	11.432	-8.61	1767	18687.49	10.673	-16.71
1648	17336.94	11.724	-2.78	1708	18033.34	11.424	-8.75	1768	18698.16	10.656	-16.84
1649	17348.66	11.721	-2.79	1709	18044.76	11.415	-8.88				
1650	17360.38	11.718	-2.80	1710	18056.17	11.406	-9.02				
1651	17372.10	11.715	-2.81	1711	18067.57	11.397	-9.15				
1652	17383.81	11.712	-2.82	1712	18078.96	11.388	-9.29				
1653	17395.52	11.709	-2.83	1713	18090.35	11.378	-9.42				
1654	17407.23	11.707	-2.84	1714	18101.72	11.369	-9.56				
1655	17418.93	11.704	-2.85	1715	18113.08	11.359	-9.69				
1656	17430.64	11.701	-2.86	1716	18124.44	11.349	-9.82				
1657	17442.34	11.698	-2.87	1717	18135.78	11.339	-9.96				
1658	17454.03	11.695	-2.88	1718	18147.12	11.329	-10.09				
1659	17465.73	11.692	-2.89	1719	18158.44	11.319	-10.23				
1660	17477.42	11.689	-2.89	1720	18169.75	11.309	-10.36				
1661	17489.11	11.687	-2.90	1721	18181.06	11.299	-10.50				
1662	17500.79	11.684	-2.91	1722	18192.35	11.288	-10.63				
1663	17512.47	11.681	-2.92	1723	18203.63	11.277	-10.77				
1664	17524.15	11.678	-2.93	1724	18214.91	11.266	-10.90				
1665	17535.83	11.675	-2.94	1725	18226.17	11.255	-11.04				
1666	17547.50	11.672	-3.08	1726	18237.42	11.244	-11.17				
1667	17559.17	11.669	-3.21	1727	18248.66	11.233	-11.31				
1668	17570.84	11.665	-3.35	1728	18259.88	11.222	-11.44				
1669	17582.50	11.662	-3.48	1729	18271.10	11.210	-11.58				
1670	17594.16	11.658	-3.62	1730	18282.30	11.199	-11.71				
1671	17605.82	11.655	-3.75	1731	18293.50	11.187	-11.85				
1672	17617.47	11.651	-3.89	1732	18304.68	11.175	-11.98				
1673	17629.12	11.647	-4.02	1733	18315.85	11.163	-12.12				
1674	17640.77	11.643	-4.16	1734	18327.00	11.151	-12.25				
1675	17652.41	11.639	-4.29	1735	18338.15	11.138	-12.39				
1676	17664.04	11.634	-4.43	1736	18349.28	11.126	-12.52				
1677	17675.68	11.630	-4.56	1737	18360.40	11.113	-12.66				
1678	17687.30	11.625	-4.70	1738	18371.51	11.101	-12.79				
1679	17698.93	11.620	-4.83	1739	18382.60	11.088	-12.93				
1680	17710.54	11.616	-4.97	1740	18393.68	11.075	-13.06				

TABLE 2.3.3. *Thermoelectric values at the fixed points for Type S thermocouples*

Fixed point	Temp. °C	E μV	S μV/°C	dS/dT nV/°C ²
Mercury FP	-38.862	-189.54	4.318	30.79
Ice Point	0.000	0.00	5.400	25.04
Ether TP	26.87	153.70	6.026	21.66
Water BP	100.000	645.34	7.333	14.56
Benzoic TP	122.37	812.88	7.640	12.91
Indium FP	156.634	1081.79	8.044	10.75
Tin FP	231.9681	1714.64	8.714	7.30
Bismuth FP	271.442	2063.97	8.977	6.04
Cadmium FP	321.108	2516.72	9.246	4.85
Lead FP	327.502	2575.94	9.276	4.72
Mercury BP	356.66	2848.34	9.406	4.20
Zinc FP	419.580	3447.87	9.643	3.39
Sulphur BP	444.674	3690.88	9.725	3.17
Cu-Al FP	548.23	4714.00	10.030	2.91
Antimony FP*	630.74	5552.10	10.295	3.68
Aluminum FP	660.37	5859.12	10.411	3.29
Silver FP	961.93	9148.20	11.403	3.29
Gold FP*	1064.43	10334.30	11.740	3.29
Copper FP	1084.5	10570.46	11.793	2.53
Nickel FP	1455	15033.80	12.085	-0.96
Cobalt FP	1494	15504.28	12.040	-1.33
Palladium FP	1554	16223.95	11.943	-1.89
Platinum FP	1767.6	18693.89	10.663	-16.79

*Junction point of different functions.

TABLE 2.3.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type S thermocouples*

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-50 to 200 °C	6	0.2	0.03	<0.01	<0.01	<0.01
200 to 400 °C	6	0.3	0.04	<0.01	<0.01	<0.01
400 to 631 °C	6	2	0.07	<0.01	<0.01	<0.01
632 to 800 °C	2	4	0.2	<0.01	<0.01	<0.01
800 to 1064 °C	2	5	0.3	<0.01	<0.01	<0.01
1065 to 1200 °C	3	6	0.4	<0.01	<0.01	<0.01
1200 to 1400 °C	3	7	0.5	<0.01	<0.01	<0.01
1400 to 1665 °C	3	9	0.6	<0.01	<0.01	<0.01
1666 to 1768 °C	3	50	4	0.02	<0.01	<0.01

3. TYPE R—Platinum–13% Rhodium Alloy Versus Platinum Thermocouples

3.1. Material Specifications and Precautions

This type is also often referred to by the nominal chemical composition of its positive thermoelement: *platinum–13% rhodium*. Until this year the composition was somewhat different from the nominal 13 percent rhodium, usually about 12.85 wt%. However, as a result of the recent research by Bedford et al. [1972], the composition of the positive thermoelement has been established to be *platinum–13.00 ± 0.05 wt% rhodium*. The negative thermoelement is commercially pure platinum. Differences between this commercial material and the platinum thermoelectric reference standard, Pt–67, are described in the next section. Differences between Pt–67 and the former standard Pt–27 are summarized in section 1.2. The effect of differences in rhodium content on the positive thermoelement is described later in this section.

During the early years of this century the *platinum–13% rhodium* versus platinum thermocouple was developed and tested in this country to give agreement with the British *platinum–10% rhodium* versus platinum thermocouples which had been found to have significant iron contamination. Fairchild and Schmitt [1922] discovered during prolonged high-temperature tests that American and British *platinum–10% rhodium* versus platinum thermocouples differed significantly from each other in thermoelectric output and stability. The main chemical difference was traced to an 0.34 percent iron impurity in the British positive thermoelement which was presumably caused by the use of impure rhodium. Many instruments and systems had been calibrated on the basis of the thermoelectric voltages of the older, impure *platinum–10% rhodium* material. Therefore, when pure rhodium was used for alloying in order to improve the stability characteristics, the composition had to be changed to give thermoelectric values near the previous ones. When the more pure rhodium was used, it was found that about 13 percent rhodium had to be alloyed into the platinum to approximately match the previous *platinum–10% rhodium* British wire. That is the highly pragmatic reason for the development of the Type R thermocouple.

Type R thermocouples have a higher Seebeck coefficient than do Type S thermocouples, about 12 percent larger over much of the range. Type R thermocouples are not standard interpolating instruments on the IPTS–68 for the 630.74 °C to gold freezing point range. Other than the above two items, and remarks on the history of development and the composition, all of the comments from the previous chapter on Type S also apply to Type R.

However, for emphasis the precautions and restrictions on usage are repeated: *They should not be used in reducing atmospheres, nor in those containing metallic vapor (such as lead or zinc), nonmetallic vapors (such as arsenic, phosphorus, or sulfur) or easily reduced oxides, unless suitably protected with*

nonmetallic protecting tubes. They should never be inserted directly into a metallic primary tube. Glawe [1970] has described the effects on thermoelectric voltages that occur from prolonged exposure at elevated temperatures in vacuum, air, and argon atmospheres.

ASTM Standard E230–72 in the Annual Book of ASTM Standards [1972] specifies that the standard limits of error for Type R commercial thermocouples be ± 1.4 °C between 0 and 538 °C and $\pm \frac{1}{4}$ percent between 538 and 1482 °C. Limits of error are not specified for Type R thermocouples below 0 °C. The recommended upper temperature limit for continuous service of protected Type R thermocouples is 1482 °C and applies to AWG 24 (0.5 mm) wire.

3.2. Data Analyses and Comparisons

The fitting functions for Type R thermocouples are taken directly from the original research recently published by Bedford et al. [1972]. Their values for thermoelectric voltages were based on the IPTS–68 and therefore no temperature scale corrections were necessary. We made only one modification to their functional expressions: the basic voltage function above 1064 °C is also expressed as a simple power series in this Monograph. For completeness their reduced temperature expression is also included in table 3.3.1.

Bedford et al. [1972] carried out research on twelve meters of wire for each thermoelement from each of four American and three British manufacturers. The National Bureau of Standards and the National Research Council calibrated the thermocouples from –50 °C to the gold freezing point (1064.43 °C); the National Physical Laboratory performed the measurements at higher temperatures. The authors gave a very thorough description of their measurement and analysis techniques.

Bedford et al. [1972] based their fitting functions and tables on average values for selected lots of wire from two manufacturers, labeled A and D. As a first step, they fit the values in the Type S defined temperature range 630.74 °C to 1064.43 °C by a cubic function. The fit had a standard deviation of 0.26 μ V for seven experimental points. Next, all of the data below 630.74 °C was fit with a seventh degree function that was constrained in value at 0 °C and 630.74 °C. The fit had a standard deviation of 0.26 μ V for 70 experimental points. The temperature range above 1064.43 °C was split in two: one range was from 1064.43 °C to 1665 °C; the other, from 1665 °C to 1767.6 °C (their measured value for the melting point of platinum; see also Quinn and Chandler [1971]). They used a reduced temperature variable for the fitting above 1064.43 °C. A cubic function constrained at 1064.43 °C was used for the first upper range; another cubic function constrained at 1665 °C was used for the

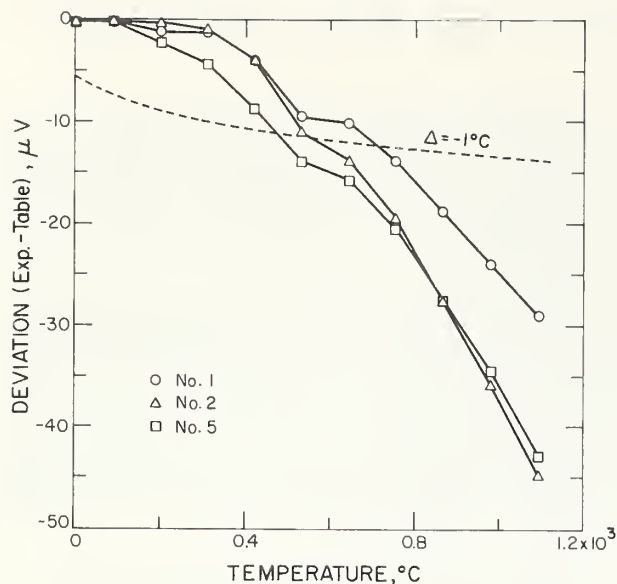


FIGURE 3.2.1. Deviations of thermoelectric voltages of Type R thermocouples—comparison of values given in this Monograph to those for typical thermocouples which conform to the previous Type R standard (NBS Circular 561).

Experimental values for thermocouples Nos. 1, 2, and 5 are from selected calibrations by the Temperature Section (NBS, Gaithersburg). Values from the previous calibrations are adjusted to the IPTS-68. The dashed line indicates a deviation of 1 °C.

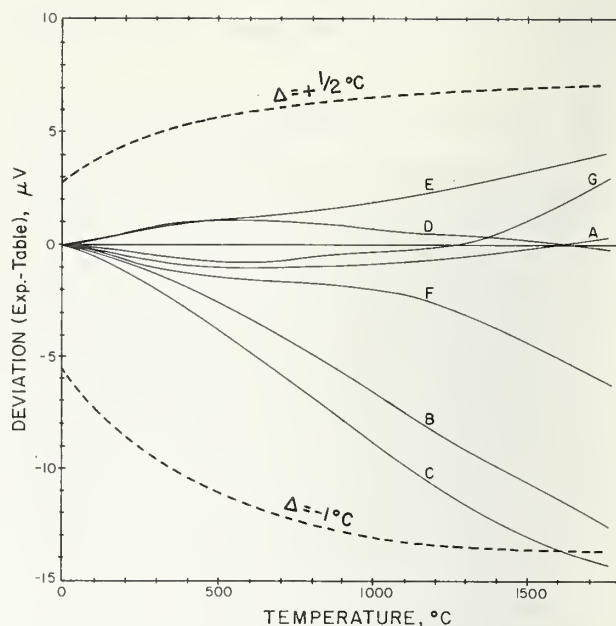


FIGURE 3.2.2. Deviation of thermoelectric voltages of Type R thermocouples—comparison of values given in this Monograph to experimental data by Bedford, et al. [1972].

All values are expressed on the IPTS-68. The upper and lower dashed lines indicate deviations of $+\frac{1}{2}$ and -1 °C respectively.

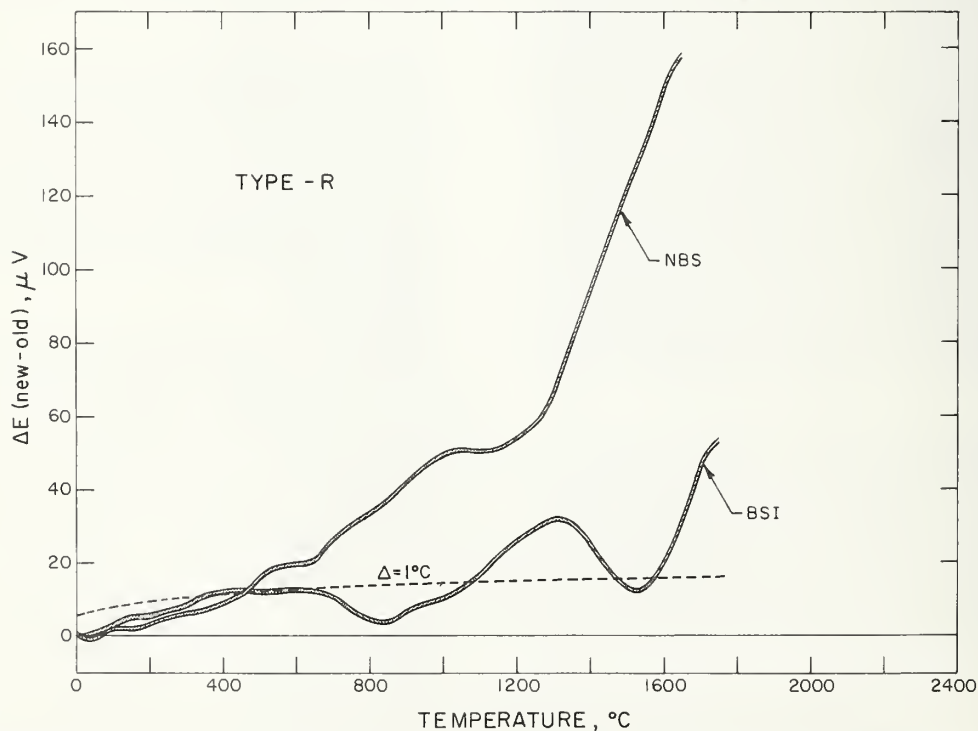


FIGURE 3.2.3. Difference in thermoelectric voltages for Type R thermocouples—comparison of values given in this Monograph to those given in: NBS Circular 561; BSI (B.S. 1826:1952).

The width of the shaded curves indicates the round-off uncertainty in the previous tabular values. Values from previous standards are adjusted to the IPTS-68. The dashed line indicates a deviation of 1 °C.

second range. The first had a standard deviation of $1.0\ \mu\text{V}$ for eight points; the second, $1.5\ \mu\text{V}$ for eight points. The maximum difference that they found between any two sets of wires was about $20\ \mu\text{V}$ at $1767\ ^\circ\text{C}$.

The values for thermoelectric voltages given in this Monograph were compared to those given in 6 calibrations (dated between 1966 and 1970) from the Temperature Section of the National Bureau of Standards in Gaithersburg. All of the thermocouples had the *older*, nominally 13 percent rhodium material for their positive thermoelement; none were from the newer, precisely 13 percent rhodium material that was used for the international comparison. Deviations are shown in figure 3.2.1 for three thermocouples representative of the older material. All values were adjusted to the IPTS-68. The systematic trend between the old material and the new tables is obvious. Deviations for thermocouples from seven different manufacturers measured by Bedford et al. [1972] (all of the *newer*, accurately 13% rhodium material) are shown in figure 3.2.2. An average of materials A and D was used by Bedford et al. [1972] for generation of their recommended functions. The negative thermoelements of materials A and D were about $6\ \mu\text{V}$ positive and $1\ \mu\text{V}$ negative, respectively, relative to Pt-67 at $1064.43\ ^\circ\text{C}$. Note that this is slightly different from the negative thermoelements that they used for Type S thermocouples.

Deviations between values given in this Monograph and those given by Shenker et al. [1955] in NBS Circular 561 and by the British Standards Institute [1952] are shown in figure 3.2.3. The earlier values were on the IPTS-48 but have been adjusted to be on the IPTS-68 for this comparison. The deviation curves indicate differences caused by variations in material

composition, experimental error and fitting techniques, in decreasing order of importance. The width of the curves represent the round-off uncertainty ($1\ \mu\text{V}$) in the tabular values quoted in the two previous standard tables.

The reference tables for Type R thermocouples given in this Monograph were derived by Bedford et al. [1972] in such a way that the thermoelectric voltage, E , is a continuous function of temperature (t_{68}) over the whole range. However, there are discontinuities in some derivatives at some of the joins in temperature ranges. These discontinuities can be clearly seen in figure 3.3.3. Bedford et al. [1972] have explained why the discontinuities are necessary. Their comments are summarized in the previous chapter.

3.3. Reference Functions and Tables for Type R Thermocouples

The coefficients for the four sets of equations for the thermoelectric voltage of Type R thermocouples are given in table 3.3.1. The reduced temperature expressions generated by Bedford et al. [1972] are included. The errors caused by using reduced bit arithmetic for calculating values of the functions are given in table 3.3.4.

The primary reference values for Type R thermocouples are given in table 3.3.2. Values at selected fixed points are given in table 3.3.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 3.3.1, 3.3.2, and 3.3.3, respectively. As with Type S thermocouples, there are discontinuities in the second derivatives where equations for different temperature regions are joined.

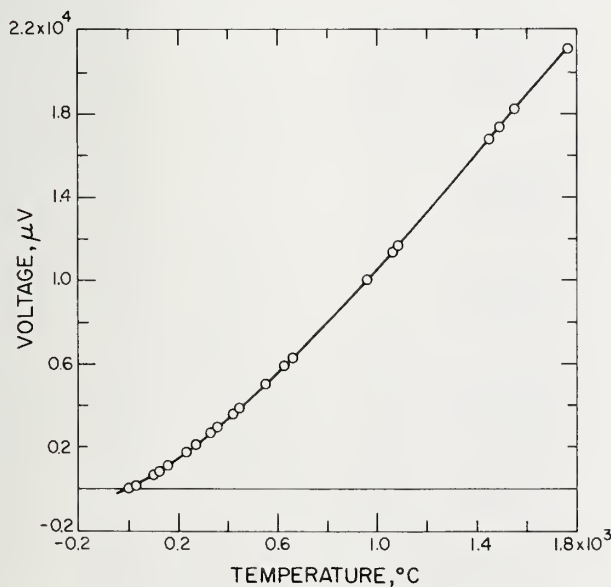


FIGURE 3.3.1. Thermoelectric voltage for Type R thermocouples. The circles indicate values at various thermometric fixed points on the IPTS-68.

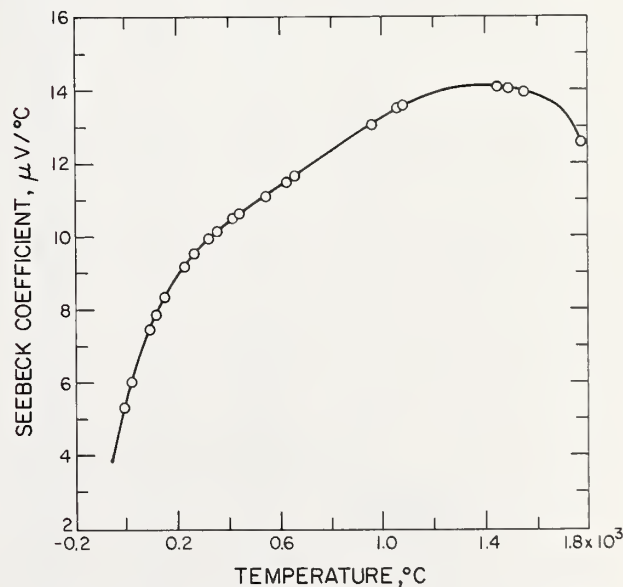


FIGURE 3.3.2. Seebeck coefficient for Type R thermocouples. The circles indicate values at various thermometric fixed points on the IPTS-68.

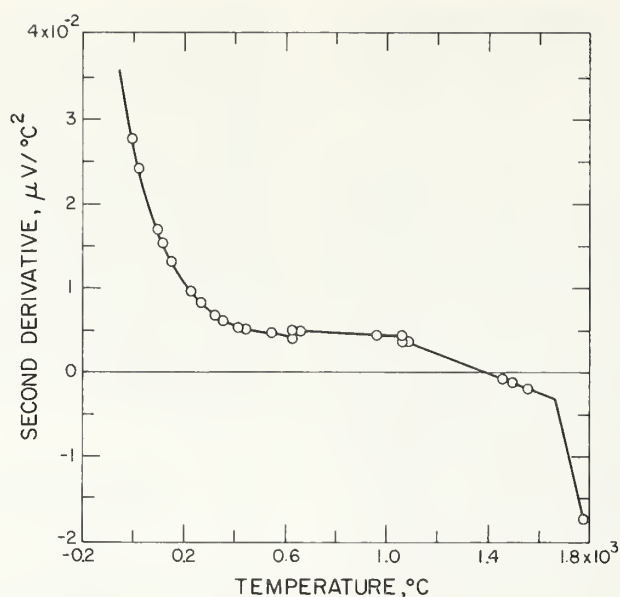


FIGURE 3.3.3. *Second derivative of thermoelectric voltage for Type R thermocouples.*

The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 3.3.1. *Power series expansion for the thermoelectric voltage of Type R thermocouples*

Temperature range	Degree	Coefficients	Term
-50 to 630.74 °C	7	$5.2891395059 \dots$ $1.3911109947 \times 10^{-2}$ $-2.4005238430 \times 10^{-5}$ $3.6201410595 \times 10^{-8}$ $-4.4645019036 \times 10^{-11}$ $3.8497691865 \times 10^{-14}$ $-1.5372641559 \times 10^{-17}$	T T^2 T^3 T^4 T^5 T^6 T^7
630.74 to 1064.43 °C	3	$-2.6418007025 \times 10^2$ $8.0468680747 \dots$ $2.9892293723 \times 10^{-3}$ $-2.6876058617 \times 10^{-7}$	\dots T^1 T^2 T^3
1064.43 to 1665 °C	3	1.4901702702×10^3 $2.8639867552 \dots$ $8.0823631189 \times 10^{-3}$ $-1.9338477638 \times 10^{-6}$	\dots T^1 T^2 T^3
1665 to 1767.6 °C	3	9.5445559910×10^4 $-1.6642500359 \times 10^2$ $1.0975743239 \times 10^{-1}$ $-2.2289216980 \times 10^{-5}$	\dots T^1 T^2 T^3
1064.43 to 1665 °C $T^* = \frac{T-1365}{300}$	3	1.5540414086×10^4 4.2357772712×10^3 1.4693087343×10^1 $-5.2213889624 \times 10^1$	\dots T^{*1} T^{*2} T^{*3}
1665 to 1767.6 °C $T^* = \frac{T-1715}{50}$	3	2.0416695016×10^4 6.6850914082×10^2 $-1.2301472524 \times 10^1$ $-2.7861521235 \dots$	\dots T^{*1} T^{*2} T^{*3}

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
				-40	-187.67	4.051	34.34	-20	-100.02	4.703	30.88
				-39	-183.61	4.085	34.16	-19	-95.30	4.733	30.72
				-38	-179.50	4.119	33.97	-18	-90.55	4.764	30.56
				-37	-175.37	4.153	33.79	-17	-85.77	4.795	30.40
				-36	-171.20	4.187	33.61	-16	-80.96	4.825	30.24
				-35	-166.99	4.221	33.44	-15	-76.12	4.855	30.08
				-34	-162.76	4.254	33.26	-14	-71.25	4.885	29.93
				-33	-158.48	4.287	33.08	-13	-66.35	4.915	29.77
				-32	-154.18	4.320	32.91	-12	-61.42	4.945	29.61
				-31	-149.84	4.353	32.73	-11	-56.46	4.974	29.46
-50	-226.44	3.698	36.23	-30	-145.48	4.386	32.56	-10	-51.48	5.004	29.31
-49	-222.72	3.735	36.03	-29	-141.07	4.418	32.39	-9	-46.46	5.033	29.15
-48	-218.97	3.770	35.84	-28	-136.64	4.450	32.22	-8	-41.41	5.062	29.00
-47	-215.18	3.806	35.65	-27	-132.17	4.482	32.05	-7	-36.33	5.091	28.85
-46	-211.36	3.842	35.46	-26	-127.67	4.514	31.88	-6	-31.23	5.120	28.70
-45	-207.50	3.877	35.27	-25	-123.14	4.546	31.71	-5	-26.09	5.148	28.55
-44	-203.60	3.912	35.08	-24	-118.58	4.578	31.54	-4	-20.93	5.177	28.41
-43	-199.67	3.947	34.89	-23	-113.99	4.609	31.38	-3	-15.74	5.205	28.26
-42	-195.71	3.982	34.71	-22	-109.36	4.641	31.21	-2	-10.52	5.233	28.11
-41	-191.71	4.017	34.52	-21	-104.71	4.672	31.05	-1	-5.28	5.261	27.97
-40	-187.67	4.051	34.34	-20	-100.02	4.703	30.88	0	0.00	5.289	27.82

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.00	5.289	27.82	60	362.68	6.728	20.57	120	800.04	7.800	15.47
1	5.30	5.317	27.68	61	369.42	6.748	20.47	121	807.85	7.816	15.40
2	10.63	5.344	27.54	62	376.18	6.769	20.37	122	815.67	7.831	15.33
3	15.99	5.372	27.39	63	382.95	6.789	20.27	123	823.51	7.846	15.26
4	21.38	5.399	27.25	64	389.75	6.809	20.17	124	831.36	7.861	15.19
5	26.79	5.426	27.11	65	396.57	6.829	20.07	125	839.23	7.877	15.12
6	32.23	5.454	26.97	66	403.41	6.849	19.97	126	847.12	7.892	15.06
7	37.70	5.480	26.83	67	410.27	6.869	19.88	127	855.02	7.907	14.99
8	43.19	5.507	26.70	68	417.15	6.889	19.78	128	862.93	7.922	14.92
9	48.71	5.534	26.56	69	424.05	6.909	19.68	129	870.86	7.937	14.85
10	54.26	5.560	26.42	70	430.97	6.929	19.59	130	878.80	7.951	14.78
11	59.83	5.587	26.29	71	437.91	6.948	19.49	131	886.76	7.966	14.72
12	65.43	5.613	26.15	72	444.87	6.967	19.40	132	894.74	7.981	14.65
13	71.06	5.639	26.02	73	451.84	6.987	19.31	133	902.72	7.995	14.58
14	76.71	5.665	25.89	74	458.84	7.006	19.21	134	910.73	8.010	14.52
15	82.39	5.691	25.76	75	465.85	7.025	19.12	135	918.78	8.024	14.45
16	88.09	5.716	25.63	76	472.89	7.044	19.03	136	926.74	8.039	14.39
17	93.82	5.742	25.49	77	479.94	7.063	18.94	137	934.82	8.053	14.32
18	99.58	5.767	25.37	78	487.02	7.082	18.85	138	942.88	8.068	14.26
19	105.36	5.793	25.24	79	494.11	7.101	18.76	139	950.96	8.082	14.19
20	111.16	5.818	25.11	80	501.22	7.120	18.67	140	959.05	8.096	14.13
21	116.99	5.843	24.98	81	508.35	7.138	18.58	141	967.15	8.110	14.07
22	122.85	5.868	24.85	82	515.49	7.157	18.49	142	975.27	8.124	14.01
23	128.73	5.893	24.73	83	522.66	7.175	18.40	143	983.40	8.138	13.94
24	134.63	5.917	24.60	84	529.85	7.194	18.31	144	991.54	8.152	13.88
25	140.56	5.942	24.48	85	537.05	7.212	18.23	145	999.70	8.166	13.82
26	146.52	5.966	24.36	86	544.27	7.230	18.14	146	1007.87	8.180	13.76
27	152.49	5.991	24.23	87	551.51	7.248	18.05	147	1016.06	8.193	13.70
28	158.50	6.015	24.11	88	558.77	7.266	17.97	148	1024.26	8.207	13.63
29	164.52	6.039	23.99	89	566.04	7.284	17.88	149	1032.47	8.221	13.57
30	170.57	6.063	23.87	90	573.33	7.302	17.80	150	1040.70	8.234	13.51
31	176.65	6.087	23.75	91	580.64	7.320	17.72	151	1048.94	8.248	13.45
32	182.75	6.110	23.63	92	587.97	7.337	17.63	152	1057.20	8.261	13.39
33	188.87	6.134	23.51	93	595.32	7.355	17.55	153	1065.47	8.274	13.34
34	195.01	6.157	23.39	94	602.68	7.373	17.47	154	1073.75	8.288	13.28
35	201.18	6.181	23.28	95	610.06	7.390	17.38	155	1082.04	8.301	13.22
36	207.38	6.204	23.16	96	617.46	7.407	17.30	156	1090.35	8.314	13.16
37	213.59	6.227	23.04	97	624.88	7.425	17.22	157	1098.67	8.327	13.10
38	219.83	6.250	22.93	98	632.31	7.442	17.14	158	1107.00	8.340	13.04
39	226.09	6.273	22.82	99	639.76	7.459	17.06	159	1115.35	8.353	12.99
40	232.38	6.296	22.70	100	647.23	7.476	16.98	160	1123.71	8.366	12.93
41	238.68	6.318	22.59	101	654.71	7.493	16.90	161	1132.08	8.379	12.87
42	245.01	6.341	22.48	102	662.22	7.510	16.82	162	1140.47	8.392	12.82
43	251.36	6.363	22.36	103	669.73	7.526	16.74	163	1148.87	8.405	12.76
44	257.74	6.385	22.25	104	677.27	7.543	16.66	164	1157.28	8.418	12.71
45	264.13	6.408	22.14	105	684.82	7.560	16.59	165	1165.70	8.430	12.65
46	270.55	6.430	22.03	106	692.39	7.576	16.51	166	1174.14	8.443	12.59
47	276.99	6.452	21.93	107	699.97	7.593	16.43	167	1182.59	8.455	12.54
48	283.46	6.474	21.82	108	707.57	7.609	16.36	168	1191.05	8.468	12.49
49	289.94	6.495	21.71	109	715.19	7.626	16.28	169	1199.52	8.480	12.43
50	296.45	6.517	21.60	110	722.83	7.642	16.21	170	1208.01	8.493	12.38
51	302.97	6.539	21.50	111	730.48	7.658	16.13	171	1216.51	8.505	12.32
52	309.52	6.560	21.39	112	738.14	7.674	16.06	172	1225.02	8.518	12.27
53	316.09	6.581	21.28	113	745.82	7.690	15.98	173	1233.54	8.530	12.22
54	322.69	6.603	21.18	114	753.52	7.706	15.91	174	1242.08	8.542	12.17
55	329.30	6.624	21.08	115	761.24	7.722	15.83	175	1250.63	8.554	12.11
56	335.93	6.645	20.97	116	768.96	7.738	15.76	176	1259.19	8.566	12.06
57	342.59	6.666	20.87	117	776.71	7.753	15.69	177	1267.76	8.578	12.01
58	349.27	6.686	20.77	118	784.47	7.769	15.62	178	1276.34	8.590	11.96
59	355.96	6.707	20.67	119	792.25	7.785	15.55	179	1284.94	8.602	11.91
60	362.68	6.728	20.57	120	800.04	7.800	15.47	180	1293.55	8.614	11.85

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	1293.55	8.614	11.85	240	1830.04	9.243	9.25	300	2400.05	9.739	7.39
181	1302.17	8.626	11.80	241	1839.28	9.252	9.21	301	2409.79	9.746	7.36
182	1310.80	8.638	11.75	242	1848.54	9.261	9.18	302	2419.54	9.754	7.34
183	1319.44	8.649	11.70	243	1857.81	9.271	9.14	303	2429.30	9.761	7.31
184	1328.10	8.661	11.65	244	1867.08	9.280	9.11	304	2439.06	9.768	7.29
185	1336.77	8.673	11.60	245	1876.36	9.289	9.07	305	2448.83	9.775	7.26
186	1345.44	8.684	11.55	246	1885.66	9.298	9.04	306	2458.61	9.783	7.24
187	1354.13	8.696	11.51	247	1894.96	9.307	9.00	307	2468.40	9.790	7.21
188	1362.84	8.707	11.46	248	1904.27	9.316	8.96	308	2478.19	9.797	7.19
189	1371.55	8.719	11.41	249	1913.59	9.325	8.93	309	2487.99	9.804	7.16
190	1380.27	8.730	11.36	250	1922.92	9.334	8.89	310	2497.80	9.811	7.14
191	1389.01	8.741	11.31	251	1932.26	9.343	8.86	311	2507.62	9.819	7.11
192	1397.76	8.753	11.26	252	1941.61	9.351	8.83	312	2517.44	9.826	7.09
193	1406.51	8.764	11.22	253	1950.96	9.360	8.79	313	2527.27	9.833	7.06
194	1415.28	8.775	11.17	254	1960.33	9.369	8.76	314	2537.10	9.840	7.04
195	1424.06	8.786	11.12	255	1969.70	9.378	8.72	315	2546.95	9.847	7.02
196	1432.86	8.797	11.08	256	1979.08	9.386	8.69	316	2556.80	9.854	6.99
197	1441.66	8.808	11.03	257	1988.47	9.395	8.66	317	2566.65	9.861	6.97
198	1450.47	8.819	10.98	258	1997.87	9.404	8.62	318	2576.52	9.868	6.95
199	1459.30	8.830	10.94	259	2007.28	9.412	8.59	319	2586.39	9.875	6.92
200	1468.13	8.841	10.89	260	2016.70	9.421	8.56	320	2596.27	9.882	6.90
201	1476.98	8.852	10.85	261	2026.12	9.429	8.52	321	2606.15	9.889	6.88
202	1485.84	8.863	10.80	262	2035.56	9.438	8.49	322	2616.05	9.895	6.86
203	1494.71	8.874	10.75	263	2045.00	9.446	8.46	323	2625.94	9.902	6.83
204	1503.59	8.884	10.71	264	2054.45	9.455	8.43	324	2635.85	9.909	6.81
205	1512.47	8.895	10.67	265	2063.91	9.463	8.40	325	2645.76	9.916	6.79
206	1521.38	8.906	10.62	266	2073.37	9.472	8.36	326	2655.68	9.923	6.77
207	1530.29	8.916	10.58	267	2082.85	9.480	8.33	327	2665.61	9.929	6.75
208	1539.21	8.927	10.53	268	2092.33	9.488	8.30	328	2675.54	9.936	6.72
209	1548.14	8.937	10.49	269	2101.83	9.497	8.27	329	2685.48	9.943	6.70
210	1557.08	8.948	10.45	270	2111.33	9.505	8.24	330	2695.43	9.950	6.68
211	1566.04	8.958	10.40	271	2120.84	9.513	8.21	331	2705.38	9.956	6.66
212	1575.00	8.969	10.36	272	2130.35	9.521	8.18	332	2715.34	9.963	6.64
213	1583.97	8.979	10.32	273	2139.88	9.529	8.15	333	2725.31	9.970	6.62
214	1592.96	8.989	10.28	274	2149.41	9.538	8.12	334	2735.28	9.976	6.60
215	1601.95	9.000	10.23	275	2158.95	9.546	8.09	335	2745.26	9.983	6.58
216	1610.96	9.010	10.19	276	2168.50	9.554	8.06	336	2755.24	9.989	6.56
217	1619.97	9.020	10.15	277	2178.06	9.562	8.03	337	2765.24	9.996	6.54
218	1629.00	9.030	10.11	278	2187.63	9.570	8.00	338	2775.24	10.002	6.52
219	1638.03	9.040	10.07	279	2197.20	9.578	7.97	339	2785.24	10.009	6.50
220	1647.08	9.050	10.03	280	2206.78	9.586	7.94	340	2795.25	10.015	6.48
221	1656.13	9.060	9.99	281	2216.37	9.594	7.91	341	2805.27	10.022	6.46
222	1665.20	9.070	9.94	282	2225.97	9.602	7.88	342	2815.30	10.028	6.44
223	1674.27	9.080	9.90	283	2235.58	9.609	7.85	343	2825.33	10.035	6.42
224	1683.36	9.090	9.86	284	2245.19	9.617	7.82	344	2835.37	10.041	6.40
225	1692.45	9.100	9.82	285	2254.81	9.625	7.79	345	2845.41	10.047	6.38
226	1701.56	9.110	9.78	286	2264.44	9.633	7.77	346	2855.46	10.054	6.36
227	1710.67	9.119	9.75	287	2274.08	9.641	7.74	347	2865.52	10.060	6.34
228	1719.80	9.129	9.71	288	2283.72	9.648	7.71	348	2875.58	10.067	6.32
229	1728.93	9.139	9.67	289	2293.37	9.656	7.68	349	2885.65	10.073	6.30
230	1738.08	9.149	9.63	290	2303.03	9.664	7.65	350	2895.73	10.079	6.28
231	1747.23	9.158	9.59	291	2312.70	9.671	7.63	351	2905.81	10.085	6.27
232	1756.39	9.168	9.55	292	2322.37	9.679	7.60	352	2915.90	10.092	6.25
233	1765.56	9.177	9.51	293	2332.06	9.687	7.57	353	2925.99	10.098	6.23
234	1774.75	9.187	9.47	294	2341.75	9.694	7.55	354	2936.09	10.104	6.21
235	1783.94	9.196	9.44	295	2351.45	9.702	7.52	355	2946.20	10.110	6.19
236	1793.14	9.206	9.40	296	2361.15	9.709	7.49	356	2956.31	10.117	6.18
237	1802.35	9.215	9.36	297	2370.86	9.717	7.47	357	2966.43	10.123	6.16
238	1811.57	9.224	9.33	298	2380.58	9.724	7.44	358	2976.56	10.129	6.14
239	1820.80	9.234	9.29	299	2390.31	9.731	7.41	359	2986.69	10.135	6.12
240	1830.04	9.243	9.25	300	2400.05	9.739	7.39	360	2996.83	10.141	6.11

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	2996.83	10.141	6.11	420	3615.74	10.481	5.31	480	4253.87	10.786	4.89
361	3006.97	10.147	6.09	421	3626.22	10.487	5.30	481	4264.66	10.790	4.88
362	3017.12	10.153	6.07	422	3636.71	10.492	5.29	482	4275.45	10.795	4.88
363	3027.28	10.159	6.06	423	3647.21	10.497	5.28	483	4286.25	10.800	4.87
364	3037.44	10.165	6.04	424	3657.71	10.502	5.27	484	4297.05	10.805	4.87
365	3047.61	10.171	6.02	425	3668.21	10.508	5.26	485	4307.86	10.810	4.86
366	3057.79	10.177	6.01	426	3678.72	10.513	5.25	486	4318.67	10.815	4.86
367	3067.97	10.183	5.99	427	3689.24	10.518	5.24	487	4329.49	10.820	4.86
368	3078.15	10.189	5.97	428	3699.76	10.523	5.23	488	4340.31	10.824	4.85
369	3088.34	10.195	5.96	429	3710.29	10.529	5.22	489	4351.14	10.829	4.85
370	3098.54	10.201	5.94	430	3720.82	10.534	5.21	490	4361.97	10.834	4.84
371	3108.75	10.207	5.93	431	3731.35	10.539	5.20	491	4372.80	10.839	4.84
372	3118.96	10.213	5.91	432	3741.89	10.544	5.20	492	4383.65	10.844	4.83
373	3129.17	10.219	5.90	433	3752.44	10.549	5.19	493	4394.49	10.849	4.83
374	3139.40	10.225	5.88	434	3762.99	10.555	5.18	494	4405.34	10.853	4.83
375	3149.62	10.231	5.86	435	3773.55	10.560	5.17	495	4416.20	10.858	4.82
376	3159.86	10.237	5.85	436	3784.11	10.565	5.16	496	4427.06	10.863	4.82
377	3170.10	10.243	5.83	437	3794.68	10.570	5.15	497	4437.93	10.868	4.82
378	3180.34	10.248	5.82	438	3805.25	10.575	5.15	498	4448.80	10.873	4.81
379	3190.59	10.254	5.81	439	3815.83	10.580	5.14	499	4459.67	10.878	4.81
380	3200.85	10.260	5.79	440	3826.41	10.586	5.13	500	4470.55	10.882	4.80
381	3211.11	10.266	5.78	441	3837.00	10.591	5.12	501	4481.44	10.887	4.80
382	3221.38	10.272	5.76	442	3847.60	10.596	5.12	502	4492.33	10.892	4.80
383	3231.66	10.277	5.75	443	3858.19	10.601	5.11	503	4503.22	10.897	4.79
384	3241.94	10.283	5.73	444	3868.80	10.606	5.10	504	4514.12	10.902	4.79
385	3252.22	10.289	5.72	445	3879.41	10.611	5.09	505	4525.02	10.906	4.79
386	3262.51	10.294	5.71	446	3890.02	10.616	5.09	506	4535.93	10.911	4.78
387	3272.81	10.300	5.69	447	3900.64	10.621	5.08	507	4546.85	10.916	4.78
388	3283.11	10.306	5.68	448	3911.26	10.626	5.07	508	4557.76	10.921	4.78
389	3293.42	10.312	5.67	449	3921.89	10.631	5.06	509	4568.69	10.925	4.77
390	3303.74	10.317	5.65	450	3932.53	10.637	5.06	510	4579.62	10.930	4.77
391	3314.06	10.323	5.64	451	3943.17	10.642	5.05	511	4590.55	10.935	4.77
392	3324.38	10.328	5.63	452	3953.81	10.647	5.04	512	4601.49	10.940	4.76
393	3334.71	10.334	5.61	453	3964.46	10.652	5.04	513	4612.43	10.945	4.76
394	3345.05	10.340	5.60	454	3975.11	10.657	5.03	514	4623.37	10.949	4.76
395	3355.39	10.345	5.59	455	3985.77	10.662	5.02	515	4634.33	10.954	4.75
396	3365.74	10.351	5.57	456	3996.44	10.667	5.02	516	4645.28	10.959	4.75
397	3376.10	10.356	5.56	457	4007.11	10.672	5.01	517	4656.24	10.964	4.75
398	3386.45	10.362	5.55	458	4017.78	10.677	5.00	518	4667.21	10.968	4.75
399	3396.82	10.368	5.54	459	4028.46	10.682	5.00	519	4678.18	10.973	4.74
400	3407.19	10.373	5.53	460	4039.14	10.687	4.99	520	4689.16	10.978	4.74
401	3417.57	10.379	5.51	461	4049.83	10.692	4.99	521	4700.14	10.983	4.74
402	3427.95	10.384	5.50	462	4060.53	10.697	4.98	522	4711.12	10.987	4.73
403	3438.33	10.390	5.49	463	4071.23	10.702	4.97	523	4722.11	10.992	4.73
404	3448.73	10.395	5.48	464	4081.93	10.707	4.97	524	4733.10	10.997	4.73
405	3459.12	10.401	5.47	465	4092.64	10.712	4.96	525	4744.10	11.001	4.72
406	3469.53	10.406	5.46	466	4103.35	10.717	4.96	526	4755.11	11.006	4.72
407	3479.94	10.411	5.44	467	4114.07	10.722	4.95	527	4766.12	11.011	4.72
408	3490.35	10.417	5.43	468	4124.80	10.727	4.95	528	4777.13	11.016	4.72
409	3500.77	10.422	5.42	469	4135.53	10.731	4.94	529	4788.15	11.020	4.71
410	3511.19	10.428	5.41	470	4146.26	10.736	4.94	530	4799.17	11.025	4.71
411	3521.62	10.433	5.40	471	4157.00	10.741	4.93	531	4810.20	11.030	4.71
412	3532.06	10.439	5.39	472	4167.74	10.746	4.93	532	4821.23	11.034	4.70
413	3542.50	10.444	5.38	473	4178.49	10.751	4.92	533	4832.27	11.039	4.70
414	3552.95	10.449	5.37	474	4189.24	10.756	4.92	534	4843.31	11.044	4.70
415	3563.40	10.455	5.36	475	4200.00	10.761	4.91	535	4854.35	11.049	4.69
416	3573.86	10.460	5.35	476	4210.77	10.766	4.91	536	4865.41	11.053	4.69
417	3584.32	10.465	5.34	477	4221.54	10.771	4.90	537	4876.46	11.058	4.69
418	3594.79	10.471	5.33	478	4232.31	10.776	4.90	538	4887.52	11.063	4.69
419	3605.26	10.476	5.32	479	4243.09	10.781	4.89	539	4898.59	11.067	4.68
420	3615.74	10.481	5.31	480	4253.87	10.786	4.89	540	4909.66	11.072	4.68

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	4909.66	11.072	4.68	600	5582.27	11.346	4.40	660	6271.59	11.641	4.91
541	4920.73	11.077	4.68	601	5593.62	11.350	4.39	661	6283.24	11.646	4.91
542	4931.81	11.081	4.67	602	5604.97	11.355	4.38	662	6294.89	11.651	4.91
543	4942.89	11.086	4.67	603	5616.33	11.359	4.38	663	6306.54	11.656	4.91
544	4953.98	11.091	4.67	604	5627.69	11.363	4.37	664	6318.20	11.661	4.91
545	4965.07	11.095	4.66	605	5639.05	11.368	4.36	665	6329.86	11.666	4.91
546	4976.17	11.100	4.66	606	5650.42	11.372	4.35	666	6341.53	11.671	4.90
547	4987.27	11.105	4.66	607	5661.80	11.376	4.34	667	6353.20	11.676	4.90
548	4998.38	11.109	4.66	608	5673.18	11.381	4.33	668	6364.88	11.681	4.90
549	5009.49	11.114	4.65	609	5684.56	11.385	4.33	669	6376.57	11.686	4.90
550	5020.61	11.119	4.65	610	5695.95	11.389	4.32	670	6388.25	11.690	4.90
551	5031.73	11.123	4.65	611	5707.34	11.394	4.31	671	6399.95	11.695	4.90
552	5042.86	11.128	4.64	612	5718.73	11.398	4.30	672	6411.64	11.700	4.89
553	5053.99	11.133	4.64	613	5730.13	11.402	4.29	673	6423.35	11.705	4.89
554	5065.12	11.137	4.64	614	5741.54	11.407	4.28	674	6435.05	11.710	4.89
555	5076.26	11.142	4.63	615	5752.95	11.411	4.27	675	6446.77	11.715	4.89
556	5087.40	11.146	4.63	616	5764.36	11.415	4.26	676	6458.48	11.720	4.89
557	5098.55	11.151	4.62	617	5775.78	11.419	4.25	677	6470.21	11.725	4.89
558	5109.71	11.156	4.62	618	5787.20	11.424	4.24	678	6481.93	11.730	4.89
559	5120.87	11.160	4.62	619	5798.62	11.428	4.23	679	6493.67	11.735	4.88
560	5132.03	11.165	4.61	620	5810.05	11.432	4.22	680	6505.40	11.739	4.88
561	5143.20	11.170	4.61	621	5821.49	11.436	4.20	681	6517.14	11.744	4.88
562	5154.37	11.174	4.61	622	5832.93	11.440	4.19	682	6528.89	11.749	4.88
563	5165.54	11.179	4.60	623	5844.37	11.445	4.18	683	6540.64	11.754	4.88
564	5176.72	11.183	4.60	624	5855.82	11.449	4.17	684	6552.40	11.759	4.88
565	5187.91	11.188	4.59	625	5867.27	11.453	4.16	685	6564.16	11.764	4.87
566	5199.10	11.193	4.59	626	5878.72	11.457	4.15	686	6575.93	11.769	4.87
567	5210.30	11.197	4.59	627	5890.18	11.461	4.13	687	6587.70	11.774	4.87
568	5221.49	11.202	4.58	628	5901.64	11.465	4.12	688	6599.47	11.778	4.87
569	5232.70	11.206	4.58	629	5913.11	11.470	4.11	689	6611.26	11.783	4.87
570	5243.91	11.211	4.57	630	5924.58	11.474	4.09	690	6623.04	11.788	4.87
571	5255.12	11.215	4.57	631	5936.06	11.478	4.96	691	6634.83	11.793	4.86
572	5266.34	11.220	4.56	632	5947.57	11.503	4.96	692	6646.63	11.798	4.86
573	5277.56	11.225	4.56	633	5959.07	11.508	4.96	693	6658.43	11.803	4.86
574	5288.79	11.229	4.56	634	5970.58	11.513	4.96	694	6670.23	11.808	4.86
575	5300.02	11.234	4.55	635	5982.10	11.518	4.95	695	6682.04	11.812	4.86
576	5311.26	11.238	4.55	636	5993.62	11.523	4.95	696	6693.86	11.817	4.86
577	5322.50	11.243	4.54	637	6005.14	11.528	4.95	697	6705.68	11.822	4.85
578	5333.74	11.247	4.54	638	6016.67	11.533	4.95	698	6717.50	11.827	4.85
579	5344.99	11.252	4.53	639	6028.21	11.538	4.95	699	6729.33	11.832	4.85
580	5356.24	11.256	4.53	640	6039.75	11.543	4.95	700	6741.17	11.837	4.85
581	5367.50	11.261	4.52	641	6051.30	11.548	4.94	701	6753.00	11.842	4.85
582	5378.77	11.265	4.52	642	6062.85	11.553	4.94	702	6764.85	11.846	4.85
583	5390.03	11.270	4.51	643	6074.40	11.558	4.94	703	6776.70	11.851	4.84
584	5401.31	11.274	4.50	644	6085.96	11.563	4.94	704	6788.55	11.856	4.84
585	5412.58	11.279	4.50	645	6097.53	11.568	4.94	705	6800.41	11.861	4.84
586	5423.86	11.283	4.49	646	6109.10	11.572	4.94	706	6812.27	11.866	4.84
587	5435.15	11.288	4.49	647	6120.67	11.577	4.94	707	6824.14	11.871	4.84
588	5446.44	11.292	4.48	648	6132.25	11.582	4.93	708	6836.01	11.875	4.84
589	5457.74	11.297	4.48	649	6143.84	11.587	4.93	709	6847.89	11.880	4.84
590	5469.03	11.301	4.47	650	6155.43	11.592	4.93	710	6859.77	11.885	4.83
591	5480.34	11.306	4.46	651	6167.02	11.597	4.93	711	6871.66	11.890	4.83
592	5491.65	11.310	4.46	652	6178.62	11.602	4.93	712	6883.55	11.895	4.83
593	5502.96	11.315	4.45	653	6190.22	11.607	4.93	713	6895.45	11.900	4.83
594	5514.28	11.319	4.44	654	6201.83	11.612	4.92	714	6907.35	11.904	4.83
595	5525.60	11.324	4.44	655	6213.45	11.617	4.92	715	6919.26	11.909	4.83
596	5536.92	11.328	4.43	656	6225.07	11.622	4.92	716	6931.17	11.914	4.82
597	5548.25	11.333	4.42	657	6236.69	11.627	4.92	717	6943.09	11.919	4.82
598	5559.59	11.337	4.42	658	6248.32	11.632	4.92	718	6955.01	11.924	4.82
599	5570.93	11.341	4.41	659	6259.95	11.637	4.92	719	6966.94	11.929	4.82
600	5582.27	11.346	4.40	660	6271.59	11.641	4.91	720	6978.87	11.933	4.82

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	6978.87	11.933	4.82	780	7703.48	12.220	4.72	840	8445.09	12.500	4.62
721	6990.80	11.938	4.82	781	7715.71	12.224	4.72	841	8457.60	12.504	4.62
722	7002.74	11.943	4.81	782	7727.93	12.229	4.72	842	8470.10	12.509	4.62
723	7014.69	11.948	4.81	783	7740.16	12.234	4.72	843	8482.61	12.514	4.62
724	7026.64	11.953	4.81	784	7752.40	12.238	4.71	844	8495.13	12.518	4.62
725	7038.59	11.957	4.81	785	7764.64	12.243	4.71	845	8507.65	12.523	4.62
726	7050.55	11.962	4.81	786	7776.89	12.248	4.71	846	8520.18	12.528	4.61
727	7062.52	11.967	4.81	787	7789.14	12.253	4.71	847	8532.71	12.532	4.61
728	7074.49	11.972	4.80	788	7801.39	12.257	4.71	848	8545.24	12.537	4.61
729	7086.46	11.977	4.80	789	7813.65	12.262	4.71	849	8557.78	12.541	4.61
730	7098.44	11.981	4.80	790	7825.91	12.267	4.70	850	8570.32	12.546	4.61
731	7110.43	11.986	4.80	791	7838.18	12.271	4.70	851	8582.87	12.551	4.61
732	7122.41	11.991	4.80	792	7850.46	12.276	4.70	852	8595.42	12.555	4.60
733	7134.41	11.996	4.80	793	7862.74	12.281	4.70	853	8607.98	12.560	4.60
734	7146.41	12.001	4.79	794	7875.02	12.285	4.70	854	8620.54	12.564	4.60
735	7158.41	12.005	4.79	795	7887.31	12.290	4.70	855	8633.11	12.569	4.60
736	7170.42	12.010	4.79	796	7899.60	12.295	4.69	856	8645.68	12.574	4.60
737	7182.43	12.015	4.79	797	7911.90	12.300	4.69	857	8658.26	12.578	4.60
738	7194.45	12.020	4.79	798	7924.20	12.304	4.69	858	8670.84	12.583	4.59
739	7206.47	12.025	4.79	799	7936.50	12.309	4.69	859	8683.42	12.587	4.59
740	7218.50	12.029	4.79	800	7948.82	12.314	4.69	860	8696.01	12.592	4.59
741	7230.53	12.034	4.78	801	7961.13	12.318	4.69	861	8708.61	12.597	4.59
742	7242.56	12.039	4.78	802	7973.45	12.323	4.69	862	8721.21	12.601	4.59
743	7254.61	12.044	4.78	803	7985.78	12.328	4.68	863	8733.81	12.606	4.59
744	7266.65	12.049	4.78	804	7998.11	12.332	4.68	864	8746.42	12.610	4.59
745	7278.70	12.053	4.78	805	8010.44	12.337	4.68	865	8759.03	12.615	4.58
746	7290.76	12.058	4.78	806	8022.78	12.342	4.68	866	8771.65	12.620	4.58
747	7302.82	12.063	4.77	807	8035.13	12.346	4.68	867	8784.27	12.624	4.58
748	7314.88	12.068	4.77	808	8047.47	12.351	4.68	868	8796.90	12.629	4.58
749	7326.95	12.072	4.77	809	8059.83	12.356	4.67	869	8809.53	12.633	4.58
750	7339.03	12.077	4.77	810	8072.19	12.360	4.67	870	8822.16	12.638	4.58
751	7351.11	12.082	4.77	811	8084.55	12.365	4.67	871	8834.80	12.642	4.57
752	7363.19	12.087	4.77	812	8096.92	12.370	4.67	872	8847.45	12.647	4.57
753	7375.28	12.091	4.76	813	8109.29	12.374	4.67	873	8860.10	12.652	4.57
754	7387.38	12.096	4.76	814	8121.67	12.379	4.67	874	8872.75	12.656	4.57
755	7399.47	12.101	4.76	815	8134.05	12.384	4.66	875	8885.41	12.661	4.57
756	7411.58	12.106	4.76	816	8146.43	12.388	4.66	876	8898.07	12.665	4.57
757	7423.69	12.111	4.76	817	8158.82	12.393	4.66	877	8910.74	12.670	4.56
758	7435.80	12.115	4.76	818	8171.22	12.398	4.66	878	8923.41	12.674	4.56
759	7447.92	12.120	4.75	819	8183.62	12.402	4.66	879	8936.09	12.679	4.56
760	7460.04	12.125	4.75	820	8196.02	12.407	4.66	880	8948.77	12.684	4.56
761	7472.17	12.130	4.75	821	8208.43	12.412	4.65	881	8961.46	12.688	4.56
762	7484.30	12.134	4.75	822	8220.85	12.416	4.65	882	8974.15	12.693	4.56
763	7496.43	12.139	4.75	823	8233.27	12.421	4.65	883	8986.84	12.697	4.55
764	7508.58	12.144	4.75	824	8245.69	12.426	4.65	884	8999.54	12.702	4.55
765	7520.72	12.149	4.74	825	8258.12	12.430	4.65	885	9012.24	12.706	4.55
766	7532.87	12.153	4.74	826	8270.55	12.435	4.65	886	9024.95	12.711	4.55
767	7545.03	12.158	4.74	827	8282.99	12.440	4.64	887	9037.67	12.715	4.55
768	7557.19	12.163	4.74	828	8295.43	12.444	4.64	888	9050.38	12.720	4.55
769	7569.35	12.167	4.74	829	8307.88	12.449	4.64	889	9063.11	12.724	4.54
770	7581.52	12.172	4.74	830	8320.33	12.454	4.64	890	9075.83	12.729	4.54
771	7593.70	12.177	4.74	831	8332.78	12.458	4.64	891	9088.56	12.734	4.54
772	7605.88	12.182	4.73	832	8345.24	12.463	4.64	892	9101.30	12.738	4.54
773	7618.06	12.186	4.73	833	8357.71	12.467	4.64	893	9114.04	12.743	4.54
774	7630.25	12.191	4.73	834	8370.18	12.472	4.63	894	9126.79	12.747	4.54
775	7642.44	12.196	4.73	835	8382.65	12.477	4.63	895	9139.54	12.752	4.54
776	7654.64	12.201	4.73	836	8395.13	12.481	4.63	896	9152.29	12.756	4.53
777	7666.85	12.205	4.73	837	8407.62	12.486	4.63	897	9165.05	12.761	4.53
778	7679.05	12.210	4.72	838	8420.10	12.491	4.63	898	9177.81	12.765	4.53
779	7691.27	12.215	4.72	839	8432.60	12.495	4.63	899	9190.58	12.770	4.53
780	7703.48	12.220	4.72	840	8445.09	12.500	4.62	900	9203.35	12.774	4.53

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	9203.35	12.774	4.53	960	9977.90	13.043	4.43	1020	10768.41	13.306	4.33
901	9216.13	12.779	4.53	961	9990.95	13.048	4.43	1021	10781.72	13.310	4.33
902	9228.91	12.783	4.52	962	10004.00	13.052	4.43	1022	10795.03	13.315	4.33
903	9241.69	12.788	4.52	963	10017.05	13.056	4.43	1023	10808.35	13.319	4.33
904	9254.48	12.792	4.52	964	10030.11	13.061	4.42	1024	10821.67	13.323	4.33
905	9267.28	12.797	4.52	965	10043.18	13.065	4.42	1025	10834.99	13.328	4.33
906	9280.08	12.802	4.52	966	10056.24	13.070	4.42	1026	10848.32	13.332	4.32
907	9292.88	12.806	4.52	967	10069.32	13.074	4.42	1027	10861.66	13.336	4.32
908	9305.69	12.811	4.51	968	10082.39	13.079	4.42	1028	10875.00	13.341	4.32
909	9318.50	12.815	4.51	969	10095.47	13.083	4.42	1029	10888.34	13.345	4.32
910	9331.32	12.820	4.51	970	10108.56	13.087	4.41	1030	10901.69	13.349	4.32
911	9344.14	12.824	4.51	971	10121.65	13.092	4.41	1031	10915.04	13.354	4.32
912	9356.97	12.829	4.51	972	10134.74	13.096	4.41	1032	10928.39	13.358	4.31
913	9369.80	12.833	4.51	973	10147.84	13.101	4.41	1033	10941.75	13.362	4.31
914	9382.63	12.838	4.50	974	10160.94	13.105	4.41	1034	10955.12	13.367	4.31
915	9395.47	12.842	4.50	975	10174.05	13.109	4.41	1035	10968.49	13.371	4.31
916	9408.32	12.847	4.50	976	10187.16	13.114	4.40	1036	10981.86	13.375	4.31
917	9421.17	12.851	4.50	977	10200.28	13.118	4.40	1037	10995.24	13.379	4.31
918	9434.02	12.856	4.50	978	10213.40	13.123	4.40	1038	11008.62	13.384	4.30
919	9446.88	12.860	4.50	979	10226.52	13.127	4.40	1039	11022.00	13.388	4.30
920	9459.74	12.865	4.49	980	10239.65	13.131	4.40	1040	11035.39	13.392	4.30
921	9472.61	12.869	4.49	981	10252.78	13.136	4.40	1041	11048.79	13.397	4.30
922	9485.48	12.874	4.49	982	10265.92	13.140	4.39	1042	11062.19	13.401	4.30
923	9498.36	12.878	4.49	983	10279.07	13.145	4.39	1043	11075.59	13.405	4.30
924	9511.24	12.883	4.49	984	10292.21	13.149	4.39	1044	11089.00	13.410	4.29
925	9524.12	12.887	4.49	985	10305.36	13.153	4.39	1045	11102.41	13.414	4.29
926	9537.01	12.892	4.49	986	10318.52	13.158	4.39	1046	11115.83	13.418	4.29
927	9549.90	12.896	4.48	987	10331.68	13.162	4.39	1047	11129.25	13.422	4.29
928	9562.80	12.901	4.48	988	10344.84	13.167	4.39	1048	11142.67	13.427	4.29
929	9575.71	12.905	4.48	989	10358.01	13.171	4.38	1049	11156.10	13.431	4.29
930	9588.61	12.909	4.48	990	10371.18	13.175	4.38	1050	11169.53	13.435	4.29
931	9601.52	12.914	4.48	991	10384.36	13.180	4.38	1051	11182.97	13.440	4.28
932	9614.44	12.918	4.48	992	10397.54	13.184	4.38	1052	11196.41	13.444	4.28
933	9627.36	12.923	4.47	993	10410.73	13.188	4.38	1053	11209.86	13.448	4.28
934	9640.29	12.927	4.47	994	10423.92	13.193	4.38	1054	11223.31	13.452	4.28
935	9653.22	12.932	4.47	995	10437.12	13.197	4.37	1055	11236.76	13.457	4.28
936	9666.15	12.936	4.47	996	10450.32	13.202	4.37	1056	11250.22	13.461	4.28
937	9679.09	12.941	4.47	997	10463.52	13.206	4.37	1057	11263.68	13.465	4.27
938	9692.03	12.945	4.47	998	10476.73	13.210	4.37	1058	11277.15	13.470	4.27
939	9704.98	12.950	4.46	999	10489.94	13.215	4.37	1059	11290.62	13.474	4.27
940	9717.93	12.954	4.46	1000	10503.16	13.219	4.37	1060	11304.10	13.478	4.27
941	9730.89	12.959	4.46	1001	10516.38	13.223	4.36	1061	11317.58	13.482	4.27
942	9743.85	12.963	4.46	1002	10529.60	13.228	4.36	1062	11331.06	13.487	4.27
943	9756.81	12.968	4.46	1003	10542.83	13.232	4.36	1063	11344.55	13.491	4.26
944	9769.78	12.972	4.46	1004	10556.07	13.236	4.36	1064	11358.05	13.495	4.26
945	9782.76	12.976	4.45	1005	10569.31	13.241	4.36	1065	11371.54	13.499	3.81
946	9795.74	12.981	4.45	1006	10582.55	13.245	4.36	1066	11385.04	13.503	3.80
947	9808.72	12.985	4.45	1007	10595.80	13.250	4.35	1067	11398.55	13.507	3.78
948	9821.71	12.990	4.45	1008	10609.05	13.254	4.35	1068	11412.06	13.511	3.77
949	9834.70	12.994	4.45	1009	10622.30	13.258	4.35	1069	11425.57	13.514	3.76
950	9847.70	12.999	4.45	1010	10635.57	13.263	4.35	1070	11439.09	13.518	3.75
951	9860.70	13.003	4.44	1011	10648.83	13.267	4.35	1071	11452.61	13.522	3.74
952	9873.70	13.008	4.44	1012	10662.10	13.271	4.35	1072	11466.13	13.526	3.73
953	9886.71	13.012	4.44	1013	10675.37	13.276	4.34	1073	11479.66	13.529	3.71
954	9899.73	13.017	4.44	1014	10688.65	13.280	4.34	1074	11493.19	13.533	3.70
955	9912.74	13.021	4.44	1015	10701.93	13.284	4.34	1075	11506.72	13.537	3.69
956	9925.77	13.025	4.44	1016	10715.22	13.289	4.34	1076	11520.26	13.540	3.68
957	9938.80	13.030	4.44	1017	10728.51	13.293	4.34	1077	11533.80	13.544	3.67
958	9951.83	13.034	4.43	1018	10741.81	13.297	4.34	1078	11547.35	13.548	3.66
959	9964.86	13.039	4.43	1019	10755.10	13.302	4.34	1079	11560.90	13.551	3.64
960	9977.90	13.043	4.43	1020	10768.41	13.306	4.33	1080	11574.45	13.555	3.63

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1080	11574.45	13.555	3.63	1140	12393.87	13.752	2.94	1200	13223.87	13.907	2.24
1081	11588.01	13.559	3.62	1141	12407.63	13.755	2.93	1201	13237.78	13.910	2.23
1082	11601.57	13.562	3.61	1142	12421.38	13.758	2.91	1202	13251.69	13.912	2.22
1083	11615.13	13.566	3.60	1143	12435.14	13.761	2.90	1203	13265.60	13.914	2.21
1084	11628.70	13.569	3.59	1144	12448.91	13.764	2.89	1204	13279.52	13.916	2.19
1085	11642.27	13.573	3.58	1145	12462.67	13.767	2.88	1205	13293.43	13.918	2.18
1086	11655.85	13.577	3.56	1146	12476.44	13.770	2.87	1206	13307.35	13.921	2.17
1087	11669.43	13.580	3.55	1147	12490.21	13.772	2.86	1207	13321.27	13.923	2.16
1088	11683.01	13.584	3.54	1148	12503.98	13.775	2.84	1208	13335.20	13.925	2.15
1089	11696.59	13.587	3.53	1149	12517.76	13.778	2.83	1209	13349.12	13.927	2.14
1090	11710.18	13.591	3.52	1150	12531.54	13.781	2.82	1210	13363.05	13.929	2.12
1091	11723.78	13.594	3.51	1151	12545.32	13.784	2.81	1211	13376.98	13.931	2.11
1092	11737.37	13.598	3.49	1152	12559.11	13.787	2.80	1212	13390.92	13.933	2.10
1093	11750.97	13.601	3.48	1153	12572.89	13.789	2.79	1213	13404.85	13.936	2.09
1094	11764.57	13.605	3.47	1154	12586.69	13.792	2.77	1214	13418.79	13.938	2.08
1095	11778.18	13.608	3.46	1155	12600.48	13.795	2.76	1215	13432.73	13.940	2.07
1096	11791.79	13.612	3.45	1156	12614.28	13.798	2.75	1216	13446.67	13.942	2.06
1097	11805.40	13.615	3.44	1157	12628.07	13.800	2.74	1217	13460.61	13.944	2.04
1098	11819.02	13.618	3.42	1158	12641.88	13.803	2.73	1218	13474.55	13.946	2.03
1099	11832.64	13.622	3.41	1159	12655.68	13.806	2.72	1219	13488.50	13.948	2.02
1100	11846.26	13.625	3.40	1160	12669.49	13.809	2.71	1220	13502.45	13.950	2.01
1101	11859.89	13.629	3.39	1161	12683.30	13.811	2.69	1221	13516.40	13.952	2.00
1102	11873.52	13.632	3.38	1162	12697.11	13.814	2.68	1222	13530.35	13.954	1.99
1103	11887.15	13.635	3.37	1163	12710.93	13.817	2.67	1223	13544.31	13.956	1.97
1104	11900.79	13.639	3.35	1164	12724.74	13.819	2.66	1224	13558.27	13.958	1.96
1105	11914.43	13.642	3.34	1165	12738.56	13.822	2.65	1225	13572.22	13.960	1.95
1106	11928.08	13.646	3.33	1166	12752.39	13.825	2.64	1226	13586.19	13.962	1.94
1107	11941.72	13.649	3.32	1167	12766.21	13.827	2.62	1227	13600.15	13.964	1.93
1108	11955.37	13.652	3.31	1168	12780.04	13.830	2.61	1228	13614.11	13.966	1.92
1109	11969.03	13.655	3.30	1169	12793.87	13.832	2.60	1229	13628.08	13.968	1.90
1110	11982.69	13.659	3.29	1170	12807.71	13.835	2.59	1230	13642.05	13.969	1.89
1111	11996.35	13.662	3.27	1171	12821.54	13.838	2.58	1231	13656.02	13.971	1.88
1112	12010.01	13.665	3.26	1172	12835.38	13.840	2.57	1232	13669.99	13.973	1.87
1113	12023.68	13.669	3.25	1173	12849.22	13.843	2.55	1233	13683.96	13.975	1.86
1114	12037.35	13.672	3.24	1174	12863.07	13.845	2.54	1234	13697.94	13.977	1.85
1115	12051.02	13.675	3.23	1175	12876.91	13.848	2.53	1235	13711.92	13.979	1.83
1116	12064.70	13.678	3.22	1176	12890.76	13.850	2.52	1236	13725.90	13.981	1.82
1117	12078.38	13.681	3.20	1177	12904.61	13.853	2.51	1237	13739.88	13.982	1.81
1118	12092.06	13.685	3.19	1178	12918.47	13.855	2.50	1238	13753.86	13.984	1.80
1119	12105.75	13.688	3.18	1179	12932.32	13.858	2.48	1239	13767.85	13.986	1.79
1120	12119.43	13.691	3.17	1180	12946.18	13.860	2.47	1240	13781.83	13.988	1.78
1121	12133.13	13.694	3.16	1181	12960.04	13.863	2.46	1241	13795.82	13.990	1.77
1122	12146.82	13.697	3.15	1182	12973.91	13.865	2.45	1242	13809.81	13.991	1.75
1123	12160.52	13.700	3.13	1183	12987.78	13.868	2.44	1243	13823.81	13.993	1.74
1124	12174.22	13.704	3.12	1184	13001.64	13.870	2.43	1244	13837.80	13.995	1.73
1125	12187.93	13.707	3.11	1185	13015.52	13.873	2.42	1245	13851.80	13.997	1.72
1126	12201.64	13.710	3.10	1186	13029.39	13.875	2.40	1246	13865.79	13.998	1.71
1127	12215.35	13.713	3.09	1187	13043.27	13.877	2.39	1247	13879.79	14.000	1.70
1128	12229.06	13.716	3.08	1188	13057.14	13.880	2.38	1248	13893.79	14.002	1.68
1129	12242.78	13.719	3.06	1189	13071.02	13.882	2.37	1249	13907.80	14.003	1.67
1130	12256.50	13.722	3.05	1190	13084.91	13.884	2.36	1250	13921.80	14.005	1.66
1131	12270.23	13.725	3.04	1191	13098.79	13.887	2.35	1251	13935.81	14.007	1.65
1132	12283.95	13.728	3.03	1192	13112.68	13.889	2.33	1252	13949.81	14.008	1.64
1133	12297.68	13.731	3.02	1193	13126.57	13.891	2.32	1253	13963.82	14.010	1.63
1134	12311.41	13.734	3.01	1194	13140.46	13.894	2.31	1254	13977.83	14.012	1.61
1135	12325.15	13.737	3.00	1195	13154.36	13.896	2.30	1255	13991.85	14.013	1.60
1136	12338.89	13.740	2.98	1196	13168.26	13.898	2.29	1256	14005.86	14.015	1.59
1137	12352.63	13.743	2.97	1197	13182.16	13.901	2.28	1257	14019.87	14.016	1.58
1138	12366.38	13.746	2.96	1198	13196.06	13.903	2.26	1258	14033.89	14.018	1.57
1139	12380.12	13.749	2.95	1199	13209.96	13.905	2.25	1259	14047.91	14.019	1.56
1140	12393.87	13.752	2.94	1200	13223.87	13.907	2.24	1260	14061.93	14.021	1.54

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1260	14061.93	14.021	1.54	1320	14905.55	14.093	0.85	1380	15752.23	14.123	0.15
1261	14075.95	14.023	1.53	1321	14919.65	14.094	0.84	1381	15766.36	14.123	0.14
1262	14089.98	14.024	1.52	1322	14933.74	14.094	0.83	1382	15780.48	14.123	0.13
1263	14104.00	14.026	1.51	1323	14947.84	14.095	0.81	1383	15794.60	14.123	0.12
1264	14118.03	14.027	1.50	1324	14961.93	14.096	0.80	1384	15808.73	14.123	0.11
1265	14132.05	14.029	1.49	1325	14976.03	14.097	0.79	1385	15822.85	14.123	0.09
1266	14146.08	14.030	1.48	1326	14990.13	14.098	0.78	1386	15836.97	14.124	0.08
1267	14160.11	14.032	1.46	1327	15004.22	14.098	0.77	1387	15851.10	14.124	0.07
1268	14174.15	14.033	1.45	1328	15018.32	14.099	0.76	1388	15865.22	14.124	0.06
1269	14188.18	14.034	1.44	1329	15032.42	14.100	0.74	1389	15879.34	14.124	0.05
1270	14202.22	14.036	1.43	1330	15046.52	14.101	0.73	1390	15893.47	14.124	0.04
1271	14216.25	14.037	1.42	1331	15060.62	14.101	0.72	1391	15907.59	14.124	0.02
1272	14230.29	14.039	1.41	1332	15074.73	14.102	0.71	1392	15921.71	14.124	0.01
1273	14244.33	14.040	1.39	1333	15088.83	14.103	0.70	1393	15935.84	14.124	0.00
1274	14258.37	14.042	1.38	1334	15102.93	14.104	0.69	1394	15949.96	14.124	-0.01
1275	14272.41	14.043	1.37	1335	15117.04	14.104	0.67	1395	15964.09	14.124	-0.02
1276	14286.46	14.044	1.36	1336	15131.14	14.105	0.66	1396	15978.21	14.124	-0.03
1277	14300.50	14.046	1.35	1337	15145.25	14.106	0.65	1397	15992.33	14.124	-0.04
1278	14314.55	14.047	1.34	1338	15159.35	14.106	0.64	1398	16006.46	14.124	-0.06
1279	14328.60	14.048	1.32	1339	15173.46	14.107	0.63	1399	16020.58	14.124	-0.07
1280	14342.64	14.050	1.31	1340	15187.56	14.107	0.62	1400	16034.71	14.124	-0.08
1281	14356.69	14.051	1.30	1341	15201.67	14.108	0.60	1401	16048.83	14.123	-0.09
1282	14370.75	14.052	1.29	1342	15215.78	14.109	0.59	1402	16062.95	14.123	-0.10
1283	14384.80	14.053	1.28	1343	15229.89	14.109	0.58	1403	16077.08	14.123	-0.11
1284	14398.85	14.055	1.27	1344	15244.00	14.110	0.57	1404	16091.20	14.123	-0.13
1285	14412.91	14.056	1.25	1345	15258.11	14.110	0.56	1405	16105.32	14.123	-0.14
1286	14426.97	14.057	1.24	1346	15272.22	14.111	0.55	1406	16119.44	14.123	-0.15
1287	14441.02	14.058	1.23	1347	15286.33	14.112	0.54	1407	16133.57	14.123	-0.16
1288	14455.08	14.060	1.22	1348	15300.44	14.112	0.52	1408	16147.69	14.123	-0.17
1289	14469.14	14.061	1.21	1349	15314.56	14.113	0.51	1409	16161.81	14.122	-0.18
1290	14483.20	14.062	1.20	1350	15328.67	14.113	0.50	1410	16175.94	14.122	-0.20
1291	14497.27	14.063	1.19	1351	15342.78	14.114	0.49	1411	16190.06	14.122	-0.21
1292	14511.33	14.065	1.17	1352	15356.90	14.114	0.48	1412	16204.18	14.122	-0.22
1293	14525.40	14.066	1.16	1353	15371.01	14.115	0.47	1413	16218.30	14.122	-0.23
1294	14539.46	14.067	1.15	1354	15385.12	14.115	0.45	1414	16232.42	14.121	-0.24
1295	14553.53	14.068	1.14	1355	15399.24	14.115	0.44	1415	16246.54	14.121	-0.25
1296	14567.60	14.069	1.13	1356	15413.36	14.116	0.43	1416	16260.66	14.121	-0.27
1297	14581.67	14.070	1.12	1357	15427.47	14.116	0.42	1417	16274.79	14.121	-0.28
1298	14595.74	14.071	1.10	1358	15441.59	14.117	0.41	1418	16288.91	14.120	-0.29
1299	14609.81	14.072	1.09	1359	15455.70	14.117	0.40	1419	16303.03	14.120	-0.30
1300	14623.88	14.074	1.08	1360	15469.82	14.117	0.38	1420	16317.15	14.120	-0.31
1301	14637.96	14.075	1.07	1361	15483.94	14.118	0.37	1421	16331.26	14.119	-0.32
1302	14652.03	14.076	1.06	1362	15498.06	14.118	0.36	1422	16345.38	14.119	-0.33
1303	14666.11	14.077	1.05	1363	15512.18	14.119	0.35	1423	16359.50	14.119	-0.35
1304	14680.19	14.078	1.03	1364	15526.29	14.119	0.34	1424	16373.62	14.118	-0.36
1305	14694.26	14.079	1.02	1365	15540.41	14.119	0.33	1425	16387.74	14.118	-0.37
1306	14708.34	14.080	1.01	1366	15554.53	14.120	0.31	1426	16401.86	14.118	-0.38
1307	14722.42	14.081	1.00	1367	15568.65	14.120	0.30	1427	16415.97	14.117	-0.39
1308	14736.50	14.082	0.99	1368	15582.77	14.120	0.29	1428	16430.09	14.117	-0.40
1309	14750.59	14.083	0.98	1369	15596.89	14.120	0.28	1429	16444.21	14.116	-0.42
1310	14764.67	14.084	0.96	1370	15611.01	14.121	0.27	1430	16458.32	14.116	-0.43
1311	14778.75	14.085	0.95	1371	15625.14	14.121	0.26	1431	16472.44	14.116	-0.44
1312	14792.84	14.086	0.94	1372	15639.26	14.121	0.25	1432	16486.56	14.115	-0.45
1313	14806.93	14.087	0.93	1373	15653.38	14.121	0.23	1433	16500.67	14.115	-0.46
1314	14821.01	14.088	0.92	1374	15667.50	14.122	0.22	1434	16514.78	14.114	-0.47
1315	14835.10	14.088	0.91	1375	15681.62	14.122	0.21	1435	16528.90	14.114	-0.49
1316	14849.19	14.089	0.90	1376	15695.74	14.122	0.20	1436	16543.01	14.113	-0.50
1317	14863.28	14.090	0.88	1377	15709.87	14.122	0.19	1437	16557.13	14.113	-0.51
1318	14877.37	14.091	0.87	1378	15723.99	14.123	0.18	1438	16571.24	14.112	-0.52
1319	14891.46	14.092	0.86	1379	15738.11	14.123	0.16	1439	16585.35	14.112	-0.53
1320	14905.55	14.093	0.85	1380	15752.23	14.123	0.15	1440	16599.46	14.111	-0.54

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1440	16599.46	14.111	-0.54	1500	17444.73	14.058	-1.24	1560	18285.54	13.962	-1.94
1441	16613.57	14.111	-0.56	1501	17458.79	14.056	-1.25	1561	18299.50	13.960	-1.95
1442	16627.68	14.110	-0.57	1502	17472.84	14.055	-1.26	1562	18313.46	13.958	-1.96
1443	16641.79	14.109	-0.58	1503	17486.90	14.054	-1.27	1563	18327.42	13.956	-1.97
1444	16655.90	14.109	-0.59	1504	17500.95	14.053	-1.29	1564	18341.37	13.954	-1.98
1445	16670.01	14.108	-0.60	1505	17515.00	14.051	-1.30	1565	18355.33	13.952	-1.99
1446	16684.12	14.108	-0.61	1506	17529.05	14.050	-1.31	1566	18369.28	13.950	-2.01
1447	16698.22	14.107	-0.62	1507	17543.10	14.049	-1.32	1567	18383.23	13.948	-2.02
1448	16712.33	14.106	-0.64	1508	17557.15	14.047	-1.33	1568	18397.17	13.946	-2.03
1449	16726.44	14.106	-0.65	1509	17571.20	14.046	-1.34	1569	18411.12	13.944	-2.04
1450	16740.54	14.105	-0.66	1510	17585.24	14.045	-1.36	1570	18425.06	13.942	-2.05
1451	16754.65	14.104	-0.67	1511	17599.29	14.043	-1.37	1571	18439.00	13.940	-2.06
1452	16768.75	14.104	-0.68	1512	17613.33	14.042	-1.38	1572	18452.94	13.938	-2.08
1453	16782.86	14.103	-0.69	1513	17627.37	14.041	-1.39	1573	18466.88	13.936	-2.09
1454	16796.96	14.102	-0.71	1514	17641.41	14.039	-1.40	1574	18480.82	13.934	-2.10
1455	16811.06	14.102	-0.72	1515	17655.45	14.038	-1.41	1575	18494.75	13.932	-2.11
1456	16825.16	14.101	-0.73	1516	17669.49	14.036	-1.43	1576	18508.68	13.930	-2.12
1457	16839.26	14.100	-0.74	1517	17683.52	14.035	-1.44	1577	18522.61	13.928	-2.13
1458	16853.36	14.099	-0.75	1518	17697.56	14.033	-1.45	1578	18536.53	13.926	-2.14
1459	16867.46	14.099	-0.76	1519	17711.59	14.032	-1.46	1579	18550.46	13.923	-2.16
1460	16881.56	14.098	-0.78	1520	17725.62	14.030	-1.47	1580	18564.38	13.921	-2.17
1461	16895.66	14.097	-0.79	1521	17739.65	14.029	-1.48	1581	18578.30	13.919	-2.18
1462	16909.75	14.096	-0.80	1522	17753.68	14.028	-1.50	1582	18592.22	13.917	-2.19
1463	16923.85	14.096	-0.81	1523	17767.70	14.026	-1.51	1583	18606.15	13.915	-2.20
1464	16937.94	14.095	-0.82	1524	17781.73	14.025	-1.52	1584	18620.04	13.913	-2.21
1465	16952.04	14.094	-0.83	1525	17795.75	14.023	-1.53	1585	18633.96	13.910	-2.23
1466	16966.13	14.093	-0.85	1526	17809.78	14.021	-1.54	1586	18647.87	13.908	-2.24
1467	16980.22	14.092	-0.86	1527	17823.80	14.020	-1.55	1587	18661.78	13.906	-2.25
1468	16994.32	14.091	-0.87	1528	17837.82	14.018	-1.56	1588	18675.68	13.904	-2.26
1469	17008.41	14.090	-0.88	1529	17851.83	14.017	-1.58	1589	18689.58	13.901	-2.27
1470	17022.50	14.090	-0.89	1530	17865.85	14.015	-1.59	1590	18703.48	13.899	-2.28
1471	17036.59	14.089	-0.90	1531	17879.86	14.014	-1.60	1591	18717.38	13.897	-2.30
1472	17050.67	14.088	-0.92	1532	17893.88	14.012	-1.61	1592	18731.28	13.894	-2.31
1473	17064.76	14.087	-0.93	1533	17907.89	14.010	-1.62	1593	18745.17	13.892	-2.32
1474	17078.85	14.086	-0.94	1534	17921.90	14.009	-1.63	1594	18759.06	13.890	-2.33
1475	17092.93	14.085	-0.95	1535	17935.90	14.007	-1.65	1595	18772.95	13.887	-2.34
1476	17107.02	14.084	-0.96	1536	17949.91	14.005	-1.66	1596	18786.84	13.885	-2.35
1477	17121.10	14.083	-0.97	1537	17963.92	14.004	-1.67	1597	18800.72	13.883	-2.37
1478	17135.18	14.082	-0.98	1538	17977.92	14.002	-1.68	1598	18814.60	13.880	-2.38
1479	17149.27	14.081	-1.00	1539	17991.92	14.000	-1.69	1599	18828.48	13.878	-2.39
1480	17163.35	14.080	-1.01	1540	18005.92	13.999	-1.70	1600	18842.36	13.876	-2.40
1481	17177.43	14.079	-1.02	1541	18019.92	13.997	-1.72	1601	18856.23	13.873	-2.41
1482	17191.50	14.078	-1.03	1542	18033.91	13.995	-1.73	1602	18870.10	13.871	-2.42
1483	17205.58	14.077	-1.04	1543	18047.91	13.994	-1.74	1603	18883.97	13.868	-2.44
1484	17219.66	14.076	-1.05	1544	18061.90	13.992	-1.75	1604	18897.84	13.866	-2.45
1485	17233.73	14.075	-1.07	1545	18075.89	13.990	-1.76	1605	18911.71	13.863	-2.46
1486	17247.81	14.074	-1.08	1546	18089.88	13.988	-1.77	1606	18925.57	13.861	-2.47
1487	17261.88	14.073	-1.09	1547	18103.87	13.987	-1.79	1607	18939.43	13.859	-2.48
1488	17275.95	14.072	-1.10	1548	18117.85	13.985	-1.80	1608	18953.29	13.856	-2.49
1489	17290.03	14.071	-1.11	1549	18131.84	13.983	-1.81	1609	18967.14	13.854	-2.50
1490	17304.10	14.069	-1.12	1550	18145.82	13.981	-1.82	1610	18980.99	13.851	-2.52
1491	17318.16	14.068	-1.14	1551	18159.80	13.979	-1.83	1611	18994.84	13.848	-2.53
1492	17332.23	14.067	-1.15	1552	18173.78	13.977	-1.84	1612	19008.69	13.846	-2.54
1493	17346.30	14.066	-1.16	1553	18187.75	13.976	-1.85	1613	19022.53	13.843	-2.55
1494	17360.36	14.065	-1.17	1554	18201.73	13.974	-1.87	1614	19036.38	13.841	-2.56
1495	17374.43	14.064	-1.18	1555	18215.70	13.972	-1.88	1615	19050.22	13.838	-2.57
1496	17388.49	14.062	-1.19	1556	18229.67	13.970	-1.89	1616	19064.05	13.836	-2.59
1497	17402.55	14.061	-1.21	1557	18243.64	13.968	-1.90	1617	19077.89	13.833	-2.60
1498	17416.61	14.060	-1.22	1558	18257.61	13.966	-1.91	1618	19091.72	13.831	-2.61
1499	17430.67	14.059	-1.23	1559	18271.57	13.964	-1.92	1619	19105.55	13.828	-2.62
1500	17444.73	14.058	-1.24	1560	18285.54	13.962	-1.94	1620	19119.37	13.825	-2.63

TABLE 3.3.2. *Type R thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1620	19119.37	13.825	-2.63	1680	19943.67	13.633	-5.16	1740	20747.53	13.082	-13.18
1621	19133.20	13.823	-2.64	1681	19957.30	13.627	-5.29	1741	20760.60	13.069	-13.32
1622	19147.02	13.820	-2.66	1682	19970.92	13.622	-5.43	1742	20773.66	13.056	-13.45
1623	19160.84	13.817	-2.67	1683	19984.54	13.617	-5.56	1743	20786.71	13.042	-13.59
1624	19174.65	13.815	-2.68	1684	19998.15	13.611	-5.70	1744	20799.75	13.029	-13.72
1625	19188.47	13.812	-2.69	1685	20011.76	13.605	-5.83	1745	20812.77	13.015	-13.85
1626	19202.28	13.809	-2.70	1686	20025.37	13.599	-5.96	1746	20825.78	13.001	-13.99
1627	19216.09	13.807	-2.71	1687	20038.96	13.593	-6.10	1747	20838.77	12.987	-14.12
1628	19229.89	13.804	-2.73	1688	20052.55	13.587	-6.23	1748	20851.75	12.973	-14.25
1629	19243.69	13.801	-2.74	1689	20066.14	13.581	-6.36	1749	20864.72	12.958	-14.39
1630	19257.49	13.798	-2.75	1690	20079.71	13.574	-6.50	1750	20877.67	12.944	-14.52
1631	19271.29	13.796	-2.76	1691	20093.28	13.568	-6.63	1751	20890.60	12.929	-14.66
1632	19285.09	13.793	-2.77	1692	20106.85	13.561	-6.77	1752	20903.53	12.915	-14.79
1633	19298.88	13.790	-2.78	1693	20120.41	13.554	-6.90	1753	20916.43	12.900	-14.92
1634	19312.67	13.787	-2.79	1694	20133.96	13.547	-7.03	1754	20929.33	12.885	-15.06
1635	19326.45	13.784	-2.81	1695	20147.50	13.540	-7.17	1755	20942.20	12.870	-15.19
1636	19340.23	13.782	-2.82	1696	20161.04	13.533	-7.30	1756	20955.06	12.854	-15.32
1637	19354.01	13.779	-2.83	1697	20174.57	13.526	-7.43	1757	20967.91	12.839	-15.46
1638	19367.79	13.776	-2.84	1698	20188.09	13.518	-7.57	1758	20980.74	12.823	-15.59
1639	19381.57	13.773	-2.85	1699	20201.60	13.511	-7.70	1759	20993.56	12.808	-15.73
1640	19395.34	13.770	-2.86	1700	20215.11	13.503	-7.84	1760	21006.36	12.792	-15.86
1641	19409.11	13.767	-2.88	1701	20228.61	13.495	-7.97	1761	21019.14	12.776	-15.99
1642	19422.87	13.765	-2.89	1702	20242.10	13.487	-8.10	1762	21031.91	12.760	-16.13
1643	19436.64	13.762	-2.90	1703	20255.58	13.479	-8.24	1763	21044.66	12.744	-16.26
1644	19450.40	13.759	-2.91	1704	20269.06	13.470	-8.37	1764	21057.40	12.727	-16.39
1645	19464.15	13.756	-2.92	1705	20282.52	13.462	-8.50	1765	21070.12	12.711	-16.53
1646	19477.91	13.753	-2.93	1706	20295.98	13.453	-8.64	1766	21082.82	12.694	-16.66
1647	19491.66	13.750	-2.95	1707	20309.43	13.445	-8.77	1767	21095.51	12.678	-16.80
1648	19505.41	13.747	-2.96	1708	20322.87	13.436	-8.91	1768	21108.17	12.661	-16.93
1649	19519.15	13.744	-2.97	1709	20336.30	13.427	-9.04				
1650	19532.90	13.741	-2.98	1710	20349.72	13.418	-9.17				
1651	19546.64	13.738	-2.99	1711	20363.14	13.408	-9.31				
1652	19560.37	13.735	-3.00	1712	20376.54	13.399	-9.44				
1653	19574.11	13.732	-3.02	1713	20389.94	13.390	-9.57				
1654	19587.84	13.729	-3.03	1714	20403.32	13.380	-9.71				
1655	19601.56	13.726	-3.04	1715	20416.70	13.370	-9.84				
1656	19615.29	13.723	-3.05	1716	20430.06	13.360	-9.97				
1657	19629.01	13.720	-3.06	1717	20443.42	13.350	-10.11				
1658	19642.73	13.717	-3.07	1718	20456.76	13.340	-10.24				
1659	19656.44	13.714	-3.08	1719	20470.10	13.330	-10.38				
1660	19670.16	13.711	-3.10	1720	20483.42	13.319	-10.51				
1661	19683.87	13.708	-3.11	1721	20496.73	13.309	-10.64				
1662	19697.57	13.704	-3.12	1722	20510.04	13.298	-10.78				
1663	19711.27	13.701	-3.13	1723	20523.33	13.287	-10.91				
1664	19724.97	13.698	-3.14	1724	20536.61	13.276	-11.04				
1665	19738.67	13.695	-3.15	1725	20549.88	13.265	-11.18				
1666	19752.36	13.692	-3.29	1726	20563.14	13.254	-11.31				
1667	19766.05	13.688	-3.42	1727	20576.39	13.242	-11.45				
1668	19779.74	13.685	-3.56	1728	20589.63	13.231	-11.58				
1669	19793.42	13.681	-3.69	1729	20602.85	13.219	-11.71				
1670	19807.10	13.678	-3.82	1730	20616.07	13.208	-11.85				
1671	19820.78	13.674	-3.96	1731	20629.27	13.196	-11.98				
1672	19834.45	13.670	-4.09	1732	20642.46	13.184	-12.11				
1673	19848.12	13.666	-4.22	1733	20655.63	13.171	-12.25				
1674	19861.78	13.661	-4.36	1734	20668.80	13.159	-12.38				
1675	19875.44	13.657	-4.49	1735	20681.95	13.147	-12.52				
1676	19889.10	13.652	-4.63	1736	20695.09	13.134	-12.65				
1677	19902.75	13.648	-4.76	1737	20708.22	13.121	-12.78				
1678	19916.39	13.643	-4.89	1738	20721.34	13.108	-12.92				
1679	19930.03	13.638	-5.03	1739	20734.44	13.095	-13.05				
1680	19943.67	13.633	-5.16	1740	20747.53	13.082	-13.18				

TABLE 3.3.3. *Thermoelectric values at the fixed points for Type R thermocouples*

Fixed point	Temp. °C	E μV	S μV/°C	dS/dT nV/°C²
Mercury FP	-38.862	-183.05	4.090	34.13
Ice Point	0.000	0.00	5.289	27.82
Ether TP	26.87	151.72	5.987	24.25
Water BP	100.000	647.23	7.476	16.98
Benzoic TP	122.37	818.57	7.837	15.31
Indium FP	156.634	1095.62	8.322	13.12
Tin FP	231.9681	1756.10	9.167	9.55
Bismuth FP	271.442	2125.04	9.517	8.19
Cadmium FP	321.108	2607.22	9.889	6.88
Lead FP	327.502	2670.59	9.933	6.74
Mercury BP	356.66	2962.99	10.121	6.16
Zinc FP	419.580	3611.34	10.479	5.31
Sulphur BP	444.674	3875.95	10.609	5.10
Cu-Al FP	548.23	5000.94	11.110	4.65
Antimony FP*	630.74	5933.08	11.477	4.08
Aluminum FP	660.37	6275.90	11.643	4.91
Silver FP	961.93	10003.09	13.052	4.43
Gold FP*	1064.43	11363.85	13.497	4.26
Copper FP	1084.5	11635.49	13.571	3.58
Nickel FP	1455	16811.06	14.102	-0.72
Cobalt FP	1494	17360.36	14.065	-1.17
Palladium FP	1554	18201.73	13.974	-1.87
Platinum FP	1767.6	21103.11	12.668	-16.88

*Junction point of different functions.

TABLE 3.3.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type R thermocouples*

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-50 to 200 °C	7	0.6	0.01	<0.01	<0.01	<0.01
200 to 400 °C	7	2	0.03	<0.01	<0.01	<0.01
400 to 631 °C	7	4	0.1	<0.01	<0.01	<0.01
632 to 800 °C	3	3	0.2	<0.01	<0.01	<0.01
800 to 1064 °C	3	3	0.2	<0.01	<0.01	<0.01
1065 to 1200 °C	3	6	0.4	<0.01	<0.01	<0.01
1200 to 1400 °C	3	7	0.5	<0.01	<0.01	<0.01
1400 to 1665 °C	3	9	0.6	<0.01	<0.01	<0.01
1666 to 1768 °C	3	50	4	0.02	<0.01	<0.01

4. TYPE B—*Platinum*–30% Rhodium Alloy Versus *Platinum*–6% Rhodium Alloy Thermocouples

4.1. Material Specifications and Precautions

This type is often referred to by the nominal chemical composition of its thermoelements—*platinum*–30% rhodium versus *platinum*–6% rhodium or “30–6”. The actual composition is somewhat different however. The positive thermoelement, BP, is usually a platinum alloy with 29.60 ± 0.2 wt% rhodium; the negative thermoelement, BN, usually has 6.12 ± 0.02 wt% rhodium. The effect of differences in rhodium content are described later in this section. Because of its favorable characteristics, the 30–6 thermocouple has rapidly gained acceptance and become widely used in this country. The Temperature Section of the National Bureau of Standards, as requested by the American Society for Testing and Materials, Committee E–20, prepared reference tables for the thermocouple to facilitate its use and calibration. Thermocouples were obtained from three manufacturers in the United States and from one European manufacturer and were calibrated by conventional methods. The results were published by Burns and Gallagher [1966].

The 30–6 thermocouple was first introduced in Europe by Degussa of Hanau, Germany. Reference curves and tables were published for their thermocouple by Obrowski and Prinz [1962]. The values of thermoelectric voltage were represented by a set of cubic equations developed from typical values at various thermometric fixed points. Differences between the values given in this Monograph and the ones reported by Obrowski and Prinz [1962] are given in the next section.

Studies by Ehringer [1954], by Walker, Ewing, and Miller [1962 and 1965], and by Glawe [1970] have demonstrated that thermocouples in which both legs are platinum-rhodium alloys are suitable for reliable temperature measurements at high temperatures. Such thermocouples have been shown to offer the following distinct advantages over the more familiar Type S (*platinum*–10% rhodium versus *platinum*) and Type R (*platinum*–13% rhodium versus *platinum*) thermocouples at high temperatures: (1) improved stability, (2) increased mechanical strength, and (3) higher possible operating temperatures. In addition to the *platinum*–rhodium thermocouple combinations which have standardized letter designations, Types S, R, and B, there are two other infrequently used combinations: *platinum*–20% rhodium versus *platinum*–5% rhodium, and *platinum*–40% rhodium versus *platinum*–20% rhodium, referred to respectively as 20–5 and 40–20 thermocouples. Reference tables for the 20–5 and 40–20 thermocouples (based on the IPTS–48) were published by Bedford [1964 and 1965].

Of the three combinations where *platinum*–rhodium alloys are used in the negative leg, the 30–6 thermocouple offers the most favorable overall characteristics and is the only one with a standardized letter designation. Although the thermoelectric characteristics of

the 30–6 thermocouple and the 20–5 thermocouple are similar, the 30–6 thermocouple offers a slightly greater Seebeck coefficient at the higher temperatures and it also has a somewhat higher tensile strength. Under similar conditions of temperature and environment, the 30–6 thermocouple shows less grain growth and less drift in calibration than either Type S or Type R thermocouples. Various physical properties of these types of thermocouples are described in the ASTM Manual STP 470 [1970] on the use of thermocouples.

The research by Burns and Gallagher [1966] indicated that the 30–6 thermocouple can be used intermittently (for several hours) up to 1800 °C and continuously (for several hundred hours) at temperatures up to about 1750 °C with only small changes in calibration. The maximum temperature limit for the thermocouple is governed, primarily, by the melting point of the Pt–6 percent Rh thermoelement which is estimated to be about 1820 °C by Acken [1934]. The thermocouple is most reliable when used in a clean oxidizing atmosphere (air) but has also been used successfully in neutral atmospheres or vacuum by Walker et al. [1962], Hendricks and McElroy [1964], Walker et al. [1965], and Glawe [1970]. The stability of the thermocouple at high temperatures has been shown by Walker et al. [1962] to depend, primarily, upon the quality of the materials used for protecting and insulating the thermocouple. High purity alumina with low iron-content appears to be the most suitable material available today for the purpose.

The ASTM Manual STP 470 [1970] indicates the following restrictions on the use of Type B thermocouples at high temperatures:

They should not be used in reducing atmospheres, nor those containing metallic or nonmetallic vapors, unless suitably protected with nonmetallic protecting tubes. They should never be inserted directly into a metallic primary protecting tube.

At temperatures below 450 °C the Seebeck coefficient of Type B thermocouples becomes quite small and is almost negligible in the normal room temperature range. Consequently, in most applications the reference junction temperature of the thermocouple does not need to be controlled or even known, as long as it is between 0 and 50 °C. For example, as shown by the reference tables, the voltage developed by the thermocouple with the reference junction at 0 °C undergoes a reversal in sign at about 43 °C, and between 0 and 50 °C varies from a minimum of about $-3 \mu\text{V}$ near 20 °C to a maximum of about $2 \mu\text{V}$ at 50 °C. Therefore, in use, if the reference junction of the thermocouple is within the range 0 to 50 °C, then a 0 °C reference junction temperature can be assumed and the error introduced will not exceed $3 \mu\text{V}$. At high temperatures (above 1100 °C) an additional error of $3 \mu\text{V}$ (about 0.3 °C) in the measurements would be significant in most instances.

Burns and Gallagher [1966] found significant differences in the purity of the *platinum*-rhodium thermoelements from the various manufacturers. Appreciable amounts of Fe, Ir, Au, Pd, Si, and Al were detected in some of the *platinum*-rhodium wires as well as small traces of Ca, Mg, B, and Cu. The amounts of impurities varied significantly from wire to wire.

In order to study the effect of varying the rhodium content of the alloys, Burns and Gallagher [1966] measured the thermoelectric voltages of four wires near 29.60 percent rhodium and of five wires near 6.12 percent rhodium. They calculated that a 0.1 percent change in the rhodium content of the *platinum*-nominally 30% rhodium thermoelement produces a corresponding change in the thermocouple voltage of about 15 μV at 1500 $^{\circ}\text{C}$. In contrast a change of only 0.01 percent in the rhodium content of *platinum*-nominally 6% rhodium thermoelement also produces a voltage change of about 15 μV at this temperature. In both cases, a decrease in the rhodium content decreases the thermoelectric voltage of that thermoelement with respect to platinum.

The thermoelectric voltage of Type B thermocouples is sensitive to their history of annealing, heat treatment and quenching. Burns and Gallagher [1966] recommend an electrical anneal in air for one hour at about 1450 $^{\circ}\text{C}$, followed by slow cooling. Calibration of Type B wires above 1600 $^{\circ}\text{C}$ is undesirable in most circumstances.

ASTM Standard E230-72 in the Annual Book of ASTM Standards [1972] specifies that the standard limits of error for Type B commercial thermocouples be $\pm \frac{1}{2}$ percent between 871 and 1705 $^{\circ}\text{C}$. Limits of error are not specified for Type B thermocouples below 871 $^{\circ}\text{C}$. The recommended upper temperature limit for protected thermocouples, 1705 $^{\circ}\text{C}$, applies to AWG 24 (0.5 mm) wire.

The information of Burns and Gallagher [1966], after updating, can be summarized as follows:

(1) Nearly all 30-6 thermocouples produced by manufacturers in this country will have thermoelectric voltages that agree with the values given in this Monograph to within the equivalent of ± 0.5 percent of the temperature in the range 500 to 1800 $^{\circ}\text{C}$ and to within $\pm 15 \mu\text{V}$ for temperatures below 500 $^{\circ}\text{C}$.

(2) Calibration of a particular 30-6 thermocouple at four points (about 600, 1064, 1300, and 1554 $^{\circ}\text{C}$) will be sufficient to construct a deviation curve from the reference table such that the resulting calibration will be accurate to within $\pm 6 \mu\text{V}$ up to 1064 $^{\circ}\text{C}$, the equivalent of about $\pm 3 \text{ }^{\circ}\text{C}$ up to 1554 $^{\circ}\text{C}$, and the equivalent of about $\pm 5 \text{ }^{\circ}\text{C}$ above.

(3) Actual calibration of the thermocouple above about 1600 $^{\circ}\text{C}$ is not recommended, since some instability may result in the thermocouple. Values above 1600 $^{\circ}\text{C}$ may be accurately determined by extrapolation.

(4) High purity alumina is recommended for insulation and protection of the thermocouple but caution should be exercised at temperatures above about 1600 $^{\circ}\text{C}$ for errors introduced by the electrical conductance of the insulators.

(5) The use of large diameter wires (at least 0.5 mm or AWG24) and larger size insulating tubes is recommended for operating temperatures above 1500 or 1600 $^{\circ}\text{C}$, so as to give the thermocouple added strength and to minimize errors due to electrical leakage.

(6) In most instances the reference junction temperature need not be controlled since the emf and thermoelectric power of the thermocouple at normal room temperatures are very small.

4.2. Data Analyses and Comparisons

The fitting functions for Type B thermocouples are based completely on original research data that had been analyzed previously by Burns and Gallagher [1966, 1970]. The values for single thermoelements versus platinum were adjusted to be on the IPTS-68 and to be relative to the present platinum thermoelectric reference standard, Pt-67. The differences between Pt-67 and the former standard, Pt-27, are summarized in section 1.2. The method of analysis was also different, of course. In particular, the method of "principal points" and spline fitting was not used for computations in this Monograph.

The data on the single thermoelements versus platinum were considered more precise than those for the total Type B combination. Therefore, data for the separate single thermoelements were used in the fitting procedures and the total combination was obtained by direct subtraction of the BN values given in the tables from the BP values. For all other thermocouple combinations, the total voltage is obtained by addition of functions for the two separate thermoelements. However, for the Type B thermocouples, both thermoelements are positive with respect to Pt-67.

For the positive thermoelement, Pt-30% Rh (BP), two wires were selected for fitting: B1 and B3 as described in section 4 of the article by Burns and Gallagher [1966]. There were 59 experimental points between 24 and 1820 $^{\circ}\text{C}$ including three extrapolated points above the highest temperature measured by Burns and Gallagher [1966], 1750 $^{\circ}\text{C}$. With an eight term function, the standard deviation of the fit was 0.8 μV .

Two different wires, also marked B1 and B3, were used for fitting of the negative thermoelement, BN. Again there were 59 experimental points, including three extrapolated points above 1750 $^{\circ}\text{C}$. With an eight term function, the standard deviation of the fit was 0.9 μV .

The values for thermoelectric voltages given in this Monograph were compared to those given in 20 calibrations (dated between 1967 and 1970) from the Temperature Section of the National Bureau of Standards in Gaithersburg and to those quoted for two other thermocouples investigated by Burns and Gallagher [1966]. In most cases the deviations were linear in temperature and usually smooth, within the precision of the data. Deviations between values in this Monograph and values reported by Burns and Gallagher [1966] for thermocouples A, B, and C are shown in figures 4.2.1, 4.2.2, and 4.2.3, for Types B,

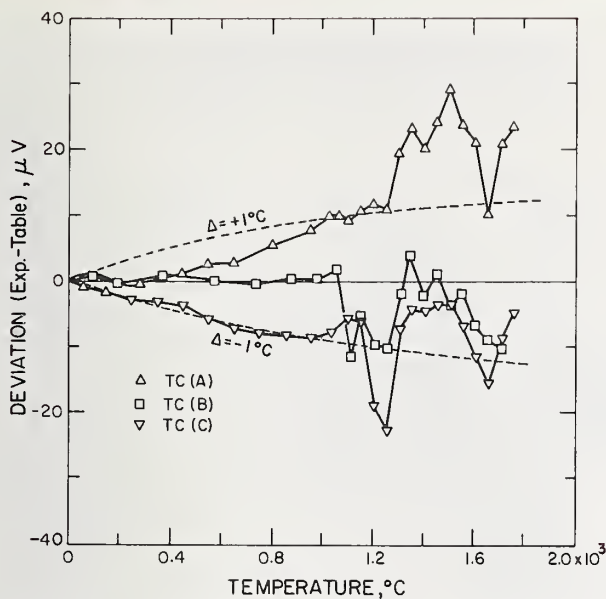


FIGURE 4.2.1. Deviations in thermoelectric voltages of Type B thermocouples—comparison of values given in this Monograph to those given for thermocouples A, B, and C by Burns and Gallagher [1966].

Values from the previous publication are adjusted to the IPTS-68. The dashed lines indicate a deviation of 1°C.

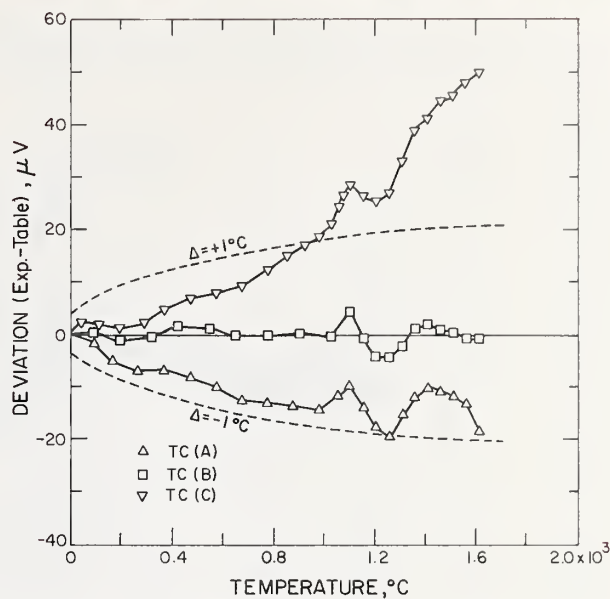


FIGURE 4.2.2. Deviations of thermoelectric voltages of Type BP thermoelements versus platinum, Pt-67—comparison of values given in this Monograph to those given for thermocouple materials A, B, and C by Burns and Gallagher [1966].

Values from the previous publication are adjusted to the IPTS-68. The dashed lines indicate a deviation of 1°C.

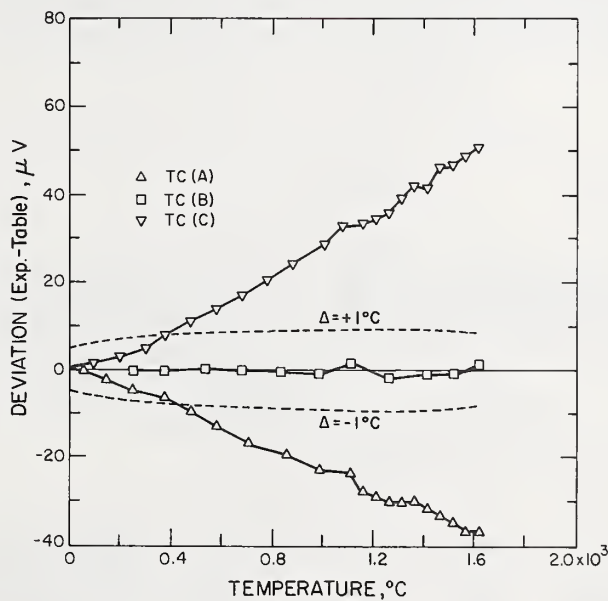


FIGURE 4.2.3. Deviations of thermoelectric voltages of Type BN thermoelements versus platinum, Pt-67—comparison of values given in this Monograph to those given for thermocouple materials A, B, and C by Burns and Gallagher [1966].

Values from the previous publication are adjusted to the IPTS-68. The dashed lines indicate a deviation of 1°C.

BP, and BN, respectively. All values were adjusted to the IPTS-68 scale.

Deviations between values given in this Monograph and those given by Burns and Gallagher [1966] are

shown in figure 4.2.4. The earlier values were adjusted to the IPTS-68. The deviation curve indicates differences caused by the different fitting techniques. The width of the curve represents the round-off un-

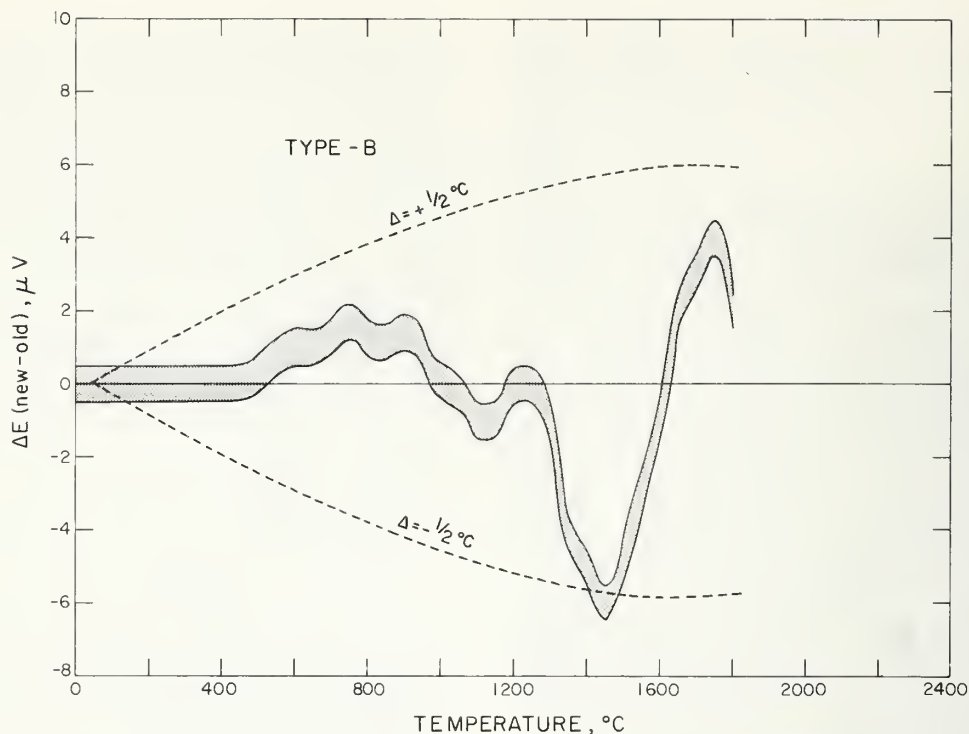


FIGURE 4.2.4. Difference in thermoelectric voltages for Type B thermocouples—comparison of values given in this Monograph to those from Burns and Gallagher [1966].

The width of the shaded curve indicates the round-off uncertainty in the previous tabular values. Values from the previous publication are adjusted to the IPTS-68. The dashed lines indicate a deviation of $\frac{1}{2}^{\circ}\text{C}$.

TABLE 4.2.1. Deviation in thermoelectric voltage between tabular values in this Monograph and the earlier Degussa calibration for Type B thermocouples

Temp., $^{\circ}\text{C}$	Deviation (NBS-Degussa), μV
500	- 5
600	- 3
700	- 0
800	- 0
900	- 2
1000	- 3
1100	- 4
1200	- 5
1300	- 7
1400	- 3
1500	+ 6
1600	+19
1700	+29
1800	+34

certainty ($1 \mu\text{V}$) in the tabular values quoted by Burns and Gallagher [1966].

Deviations between values given in this Monograph and those given by Obrowski and Prinz [1962] for the Degussa calibration are tabulated in table 4.2.1. The older values have been adjusted to be on the IPTS-68.

4.3. Reference Functions and Tables for Type B Thermocouples

The coefficients for the eighth degree expansion for the thermoelectric voltage of Type B thermocouples are given in table 4.3.1. The errors caused by using reduced bit arithmetic for calculating values of the functions are given in table 4.3.4.

The primary reference values for Type B thermocouples are given in table 4.3.2. Values at selected fixed points are given in table 4.3.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 4.3.1, 4.3.2, and 4.3.3, respectively.

TABLE 4.3.1. Power series expansion for the thermoelectric voltage of Type B thermocouples

Temperature range	Degree	Coefficients	Term
0 to 1820 °C	8	$-2.4674601620 \times 10^{-1}$	T
		$5.9102111169 \times 10^{-3}$	T^2
		$-1.4307123430 \times 10^{-6}$	T^3
		$2.1509149750 \times 10^{-9}$	T^4
		$-3.1757800720 \times 10^{-12}$	T^5
		$2.4010367459 \times 10^{-15}$	T^6
		$-9.0928148159 \times 10^{-19}$	T^7
		$1.3299505137 \times 10^{-22}$	T^8

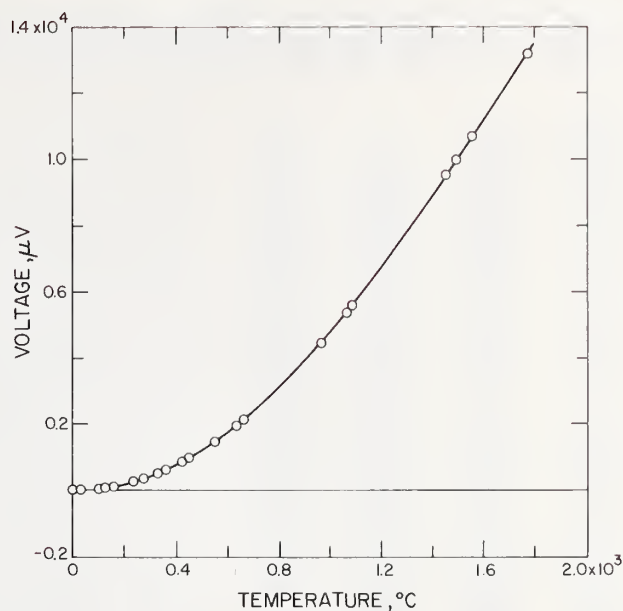


FIGURE 4.3.1. Thermoelectric voltage for Type B thermocouples.

The circles indicate values at various thermometric fixed points on the IPTS-68.

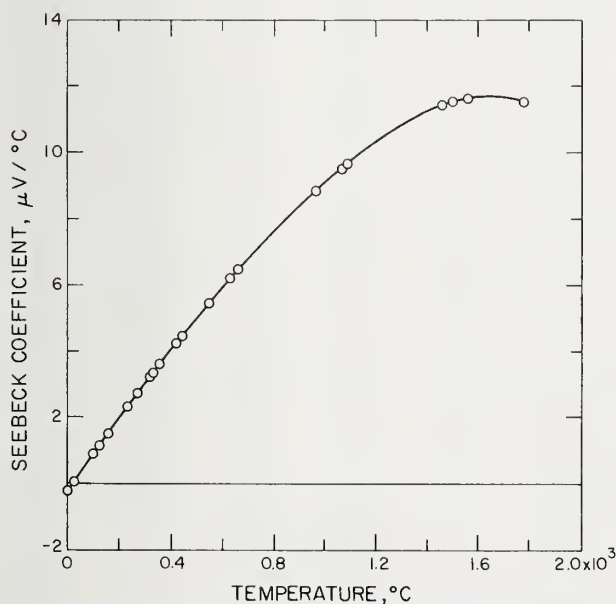


FIGURE 4.3.2. Seebeck coefficient for Type B thermocouples.

The circles indicate values at various thermometric fixed points on the IPTS-68.

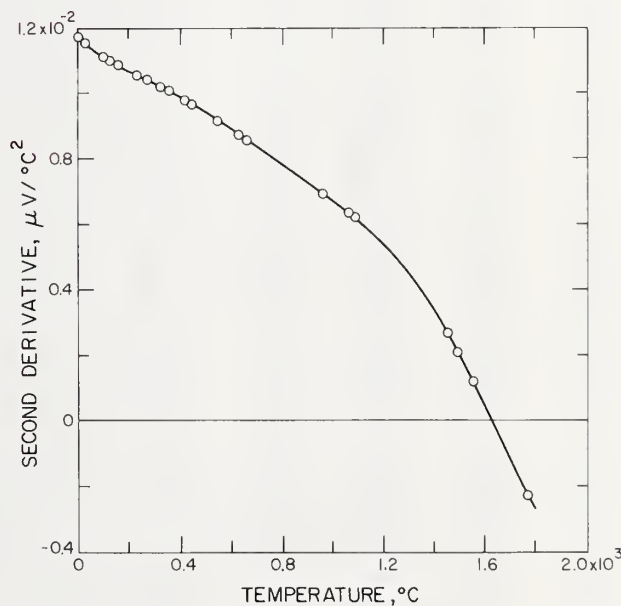


FIGURE 4.3.3. Second derivative of thermoelectric voltage for Type B thermocouples.

The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.00	-0.247	11.82	60	6.19	0.449	11.39	120	53.40	1.122	11.07
1	-0.24	-0.235	11.81	61	6.64	0.460	11.38	121	54.53	1.133	11.06
2	-0.47	-0.223	11.80	62	7.11	0.471	11.37	122	55.66	1.144	11.06
3	-0.69	-0.211	11.79	63	7.59	0.483	11.37	123	56.81	1.155	11.05
4	-0.89	-0.200	11.79	64	8.07	0.494	11.36	124	57.97	1.166	11.05
5	-1.09	-0.188	11.78	65	8.57	0.506	11.36	125	59.15	1.177	11.04
6	-1.27	-0.176	11.77	66	9.09	0.517	11.35	126	60.33	1.188	11.04
7	-1.44	-0.164	11.76	67	9.61	0.528	11.34	127	61.52	1.199	11.03
8	-1.60	-0.152	11.75	68	10.14	0.540	11.34	128	62.73	1.210	11.03
9	-1.74	-0.141	11.75	69	10.69	0.551	11.33	129	63.94	1.221	11.02
10	-1.88	-0.129	11.74	70	11.24	0.562	11.33	130	65.17	1.232	11.02
11	-2.00	-0.117	11.73	71	11.81	0.574	11.32	131	66.41	1.243	11.02
12	-2.11	-0.106	11.72	72	12.39	0.585	11.31	132	67.66	1.254	11.01
13	-2.21	-0.094	11.71	73	12.98	0.596	11.31	133	68.92	1.265	11.01
14	-2.30	-0.082	11.71	74	13.58	0.608	11.30	134	70.19	1.276	11.00
15	-2.38	-0.070	11.70	75	14.20	0.619	11.30	135	71.47	1.287	11.00
16	-2.44	-0.059	11.69	76	14.82	0.630	11.29	136	72.76	1.298	10.99
17	-2.49	-0.047	11.68	77	15.46	0.641	11.29	137	74.07	1.309	10.99
18	-2.53	-0.035	11.67	78	16.10	0.653	11.28	138	75.38	1.320	10.98
19	-2.56	-0.024	11.67	79	16.76	0.664	11.27	139	76.71	1.331	10.98
20	-2.58	-0.012	11.66	80	17.43	0.675	11.27	140	78.04	1.342	10.98
21	-2.59	-0.000	11.65	81	18.11	0.686	11.26	141	79.39	1.353	10.97
22	-2.58	0.011	11.64	82	18.80	0.698	11.26	142	80.75	1.364	10.97
23	-2.57	0.023	11.64	83	19.51	0.709	11.25	143	82.12	1.375	10.96
24	-2.54	0.035	11.63	84	20.22	0.720	11.25	144	83.50	1.386	10.96
25	-2.50	0.046	11.62	85	20.95	0.731	11.24	145	84.89	1.397	10.95
26	-2.44	0.058	11.61	86	21.69	0.743	11.24	146	86.29	1.408	10.95
27	-2.38	0.069	11.61	87	22.43	0.754	11.23	147	87.71	1.419	10.95
28	-2.31	0.081	11.60	88	23.19	0.765	11.23	148	89.13	1.430	10.94
29	-2.22	0.093	11.59	89	23.96	0.776	11.22	149	90.57	1.441	10.94
30	-2.12	0.104	11.58	90	24.75	0.788	11.22	150	92.01	1.452	10.93
31	-2.01	0.116	11.58	91	25.54	0.799	11.21	151	93.47	1.463	10.93
32	-1.89	0.127	11.57	92	26.34	0.810	11.20	152	94.94	1.474	10.92
33	-1.76	0.139	11.56	93	27.16	0.821	11.20	153	96.42	1.485	10.92
34	-1.61	0.151	11.56	94	27.99	0.832	11.19	154	97.91	1.495	10.92
35	-1.45	0.162	11.55	95	28.82	0.844	11.19	155	99.41	1.506	10.91
36	-1.29	0.174	11.54	96	29.67	0.855	11.18	156	100.92	1.517	10.91
37	-1.11	0.185	11.54	97	30.53	0.866	11.18	157	102.44	1.528	10.90
38	-0.92	0.197	11.53	98	31.41	0.877	11.17	158	103.98	1.539	10.90
39	-0.71	0.208	11.52	99	32.29	0.888	11.17	159	105.52	1.550	10.90
40	-0.50	0.220	11.51	100	33.18	0.900	11.16	160	107.08	1.561	10.89
41	-0.27	0.231	11.51	101	34.09	0.911	11.16	161	108.64	1.572	10.89
42	-0.04	0.243	11.50	102	35.00	0.922	11.15	162	110.22	1.583	10.88
43	0.21	0.254	11.49	103	35.93	0.933	11.15	163	111.81	1.594	10.88
44	0.47	0.266	11.49	104	36.87	0.944	11.14	164	113.41	1.604	10.87
45	0.74	0.277	11.48	105	37.82	0.955	11.14	165	115.02	1.615	10.87
46	1.03	0.289	11.47	106	38.78	0.966	11.13	166	116.64	1.626	10.87
47	1.32	0.300	11.47	107	39.75	0.978	11.13	167	118.27	1.637	10.86
48	1.63	0.312	11.46	108	40.74	0.989	11.12	168	119.91	1.648	10.86
49	1.94	0.323	11.45	109	41.73	1.000	11.12	169	121.56	1.659	10.85
50	2.27	0.335	11.45	110	42.74	1.011	11.11	170	123.23	1.670	10.85
51	2.61	0.346	11.44	111	43.75	1.022	11.11	171	124.90	1.680	10.85
52	2.96	0.357	11.44	112	44.78	1.033	11.10	172	126.59	1.691	10.84
53	3.33	0.369	11.43	113	45.82	1.044	11.10	173	128.29	1.702	10.84
54	3.70	0.380	11.42	114	46.87	1.055	11.09	174	129.99	1.713	10.83
55	4.09	0.392	11.42	115	47.93	1.066	11.09	175	131.71	1.724	10.83
56	4.48	0.403	11.41	116	49.00	1.078	11.09	176	133.44	1.735	10.83
57	4.89	0.415	11.40	117	50.08	1.089	11.08	177	135.18	1.745	10.82
58	5.31	0.426	11.40	118	51.18	1.100	11.08	178	136.93	1.756	10.82
59	5.75	0.437	11.39	119	52.28	1.111	11.07	179	138.69	1.767	10.81
60	6.19	0.449	11.39	120	53.40	1.122	11.07	180	140.47	1.778	10.81

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	140.47	1.778	10.81	240	266.46	2.419	10.58	300	430.53	3.047	10.35
181	142.25	1.789	10.81	241	268.88	2.430	10.58	301	433.58	3.058	10.35
182	144.04	1.799	10.80	242	271.32	2.441	10.57	302	436.65	3.068	10.34
183	145.85	1.810	10.80	243	273.76	2.451	10.57	303	439.72	3.078	10.34
184	147.66	1.821	10.79	244	276.22	2.462	10.56	304	442.80	3.089	10.33
185	149.49	1.832	10.79	245	278.69	2.472	10.56	305	445.90	3.099	10.33
186	151.33	1.843	10.79	246	281.16	2.483	10.56	306	449.00	3.109	10.33
187	153.18	1.853	10.78	247	283.65	2.493	10.55	307	452.12	3.120	10.32
188	155.04	1.864	10.78	248	286.15	2.504	10.55	308	455.24	3.130	10.32
189	156.91	1.875	10.77	249	288.66	2.515	10.54	309	458.38	3.140	10.31
190	158.79	1.886	10.77	250	291.18	2.525	10.54	310	461.52	3.151	10.31
191	160.68	1.897	10.77	251	293.71	2.536	10.54	311	464.68	3.161	10.31
192	162.58	1.907	10.76	252	296.25	2.546	10.53	312	467.84	3.171	10.30
193	164.49	1.918	10.76	253	298.80	2.557	10.53	313	471.02	3.182	10.30
194	166.41	1.929	10.75	254	301.36	2.567	10.53	314	474.21	3.192	10.29
195	168.35	1.940	10.75	255	303.94	2.578	10.52	315	477.40	3.202	10.29
196	170.29	1.950	10.75	256	306.52	2.588	10.52	316	480.61	3.212	10.29
197	172.25	1.961	10.74	257	309.11	2.599	10.51	317	483.83	3.223	10.28
198	174.22	1.972	10.74	258	311.72	2.609	10.51	318	487.06	3.233	10.28
199	176.19	1.983	10.74	259	314.33	2.620	10.51	319	490.29	3.243	10.27
200	178.18	1.993	10.73	260	316.96	2.630	10.50	320	493.54	3.254	10.27
201	180.18	2.004	10.73	261	319.59	2.641	10.50	321	496.80	3.264	10.27
202	182.19	2.015	10.72	262	322.24	2.651	10.50	322	500.07	3.274	10.26
203	184.21	2.025	10.72	263	324.90	2.662	10.49	323	503.35	3.284	10.26
204	186.24	2.036	10.72	264	327.56	2.672	10.49	324	506.64	3.295	10.25
205	188.28	2.047	10.71	265	330.24	2.683	10.48	325	509.94	3.305	10.25
206	190.33	2.058	10.71	266	332.93	2.693	10.48	326	513.25	3.315	10.25
207	192.40	2.068	10.70	267	335.63	2.704	10.48	327	516.57	3.325	10.24
208	194.47	2.079	10.70	268	338.34	2.714	10.47	328	519.90	3.336	10.24
209	196.55	2.090	10.70	269	341.06	2.725	10.47	329	523.24	3.346	10.23
210	198.65	2.100	10.69	270	343.79	2.735	10.47	330	526.59	3.356	10.23
211	200.76	2.111	10.69	271	346.53	2.746	10.46	331	529.95	3.366	10.23
212	202.87	2.122	10.69	272	349.28	2.756	10.46	332	533.32	3.377	10.22
213	205.00	2.132	10.68	273	352.04	2.767	10.45	333	536.71	3.387	10.22
214	207.14	2.143	10.68	274	354.81	2.777	10.45	334	540.10	3.397	10.21
215	209.29	2.154	10.67	275	357.59	2.787	10.45	335	543.50	3.407	10.21
216	211.44	2.165	10.67	276	360.38	2.798	10.44	336	546.91	3.417	10.21
217	213.61	2.175	10.67	277	363.19	2.808	10.44	337	550.33	3.428	10.20
218	215.80	2.186	10.66	278	366.00	2.819	10.43	338	553.77	3.438	10.20
219	217.99	2.196	10.66	279	368.82	2.829	10.43	339	557.21	3.448	10.19
220	220.19	2.207	10.65	280	371.66	2.840	10.43	340	560.66	3.458	10.19
221	222.40	2.218	10.65	281	374.50	2.850	10.42	341	564.13	3.468	10.19
222	224.62	2.228	10.65	282	377.36	2.860	10.42	342	567.60	3.479	10.18
223	226.86	2.239	10.64	283	380.22	2.871	10.42	343	571.08	3.489	10.18
224	229.10	2.250	10.64	284	383.10	2.881	10.41	344	574.58	3.499	10.17
225	231.36	2.260	10.64	285	385.99	2.892	10.41	345	578.08	3.509	10.17
226	233.62	2.271	10.63	286	388.88	2.902	10.40	346	581.60	3.519	10.17
227	235.90	2.282	10.63	287	391.79	2.912	10.40	347	585.12	3.529	10.16
228	238.19	2.292	10.62	288	394.71	2.923	10.40	348	588.65	3.540	10.16
229	240.48	2.303	10.62	289	397.64	2.933	10.39	349	592.20	3.550	10.15
230	242.79	2.314	10.62	290	400.58	2.944	10.39	350	595.75	3.560	10.15
231	245.11	2.324	10.61	291	403.52	2.954	10.38	351	599.32	3.570	10.14
232	247.44	2.335	10.61	292	406.48	2.964	10.38	352	602.89	3.580	10.14
233	249.78	2.345	10.61	293	409.45	2.975	10.38	353	606.48	3.590	10.14
234	252.13	2.356	10.60	294	412.43	2.985	10.37	354	610.07	3.600	10.13
235	254.49	2.367	10.60	295	415.42	2.996	10.37	355	613.68	3.611	10.13
236	256.86	2.377	10.59	296	418.42	3.006	10.36	356	617.30	3.621	10.12
237	259.25	2.388	10.59	297	421.44	3.016	10.36	357	620.92	3.631	10.12
238	261.64	2.398	10.59	298	424.46	3.027	10.36	358	624.56	3.641	10.12
239	264.04	2.409	10.58	299	427.49	3.037	10.35	359	628.20	3.651	10.11
240	266.46	2.419	10.58	300	430.53	3.047	10.35	360	631.86	3.661	10.11

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	631.86	3.661	10.11	420	869.57	4.260	9.85	480	1142.71	4.842	9.56
361	635.53	3.671	10.10	421	873.83	4.270	9.84	481	1147.56	4.852	9.56
362	639.20	3.681	10.10	422	878.11	4.279	9.84	482	1152.41	4.861	9.55
363	642.89	3.691	10.09	423	882.39	4.289	9.83	483	1157.28	4.871	9.55
364	646.58	3.702	10.09	424	886.68	4.299	9.83	484	1162.16	4.880	9.54
365	650.29	3.712	10.09	425	890.99	4.309	9.82	485	1167.04	4.890	9.54
366	654.01	3.722	10.08	426	895.30	4.319	9.82	486	1171.94	4.899	9.54
367	657.73	3.732	10.08	427	899.63	4.329	9.81	487	1176.84	4.909	9.53
368	661.47	3.742	10.07	428	903.96	4.338	9.81	488	1181.75	4.919	9.53
369	665.22	3.752	10.07	429	908.30	4.348	9.80	489	1186.68	4.928	9.52
370	668.98	3.762	10.06	430	912.66	4.358	9.80	490	1191.61	4.938	9.52
371	672.74	3.772	10.06	431	917.02	4.368	9.80	491	1196.55	4.947	9.51
372	676.52	3.782	10.06	432	921.39	4.378	9.79	492	1201.50	4.957	9.51
373	680.31	3.792	10.05	433	925.77	4.387	9.79	493	1206.47	4.966	9.50
374	684.10	3.802	10.05	434	930.17	4.397	9.78	494	1211.44	4.976	9.50
375	687.91	3.812	10.04	435	934.57	4.407	9.78	495	1216.42	4.985	9.49
376	691.73	3.822	10.04	436	938.98	4.417	9.77	496	1221.41	4.995	9.49
377	695.56	3.832	10.03	437	943.40	4.427	9.77	497	1226.41	5.004	9.48
378	699.39	3.842	10.03	438	947.83	4.436	9.76	498	1231.42	5.014	9.48
379	703.24	3.852	10.03	439	952.27	4.446	9.76	499	1236.43	5.023	9.47
380	707.10	3.862	10.02	440	956.73	4.456	9.75	500	1241.46	5.033	9.47
381	710.97	3.872	10.02	441	961.19	4.466	9.75	501	1246.50	5.042	9.46
382	714.84	3.882	10.01	442	965.66	4.475	9.74	502	1251.55	5.051	9.46
383	718.73	3.892	10.01	443	970.14	4.485	9.74	503	1256.60	5.061	9.45
384	722.63	3.902	10.00	444	974.63	4.495	9.74	504	1261.67	5.070	9.45
385	726.54	3.912	10.00	445	979.13	4.505	9.73	505	1266.74	5.080	9.44
386	730.45	3.922	10.00	446	983.64	4.514	9.73	506	1271.83	5.089	9.44
387	734.38	3.932	9.99	447	988.16	4.524	9.72	507	1276.92	5.099	9.43
388	738.32	3.942	9.99	448	992.68	4.534	9.72	508	1282.02	5.108	9.43
389	742.27	3.952	9.98	449	997.22	4.543	9.71	509	1287.14	5.118	9.42
390	746.22	3.962	9.98	450	1001.77	4.553	9.71	510	1292.26	5.127	9.42
391	750.19	3.972	9.97	451	1006.33	4.563	9.70	511	1297.39	5.136	9.41
392	754.17	3.982	9.97	452	1010.90	4.573	9.70	512	1302.53	5.146	9.41
393	758.15	3.992	9.97	453	1015.47	4.582	9.69	513	1307.68	5.155	9.40
394	762.15	4.002	9.96	454	1020.06	4.592	9.69	514	1312.84	5.165	9.40
395	766.16	4.012	9.96	455	1024.66	4.602	9.68	515	1318.01	5.174	9.39
396	770.18	4.022	9.95	456	1029.26	4.611	9.68	516	1323.19	5.183	9.39
397	774.20	4.032	9.95	457	1033.88	4.621	9.67	517	1328.38	5.193	9.38
398	778.24	4.042	9.94	458	1038.51	4.631	9.67	518	1333.58	5.202	9.38
399	782.29	4.052	9.94	459	1043.14	4.640	9.66	519	1338.78	5.211	9.37
400	786.35	4.062	9.93	460	1047.79	4.650	9.66	520	1344.00	5.221	9.37
401	790.41	4.072	9.93	461	1052.44	4.660	9.66	521	1349.22	5.230	9.36
402	794.49	4.082	9.93	462	1057.11	4.669	9.65	522	1354.46	5.240	9.36
403	798.58	4.092	9.92	463	1061.78	4.679	9.65	523	1359.70	5.249	9.35
404	802.67	4.102	9.92	464	1066.46	4.689	9.64	524	1364.96	5.258	9.35
405	806.78	4.112	9.91	465	1071.16	4.698	9.64	525	1370.22	5.268	9.34
406	810.90	4.122	9.91	466	1075.86	4.708	9.63	526	1375.49	5.277	9.34
407	815.02	4.131	9.90	467	1080.57	4.717	9.63	527	1380.77	5.286	9.33
408	819.16	4.141	9.90	468	1085.29	4.727	9.62	528	1386.06	5.296	9.33
409	823.31	4.151	9.89	469	1090.03	4.737	9.62	529	1391.37	5.305	9.32
410	827.46	4.161	9.89	470	1094.77	4.746	9.61	530	1396.67	5.314	9.32
411	831.63	4.171	9.89	471	1099.52	4.756	9.61	531	1401.99	5.324	9.31
412	835.80	4.181	9.88	472	1104.28	4.766	9.60	532	1407.32	5.333	9.31
413	839.99	4.191	9.88	473	1109.05	4.775	9.60	533	1412.66	5.342	9.30
414	844.18	4.201	9.87	474	1113.83	4.785	9.59	534	1418.01	5.351	9.30
415	848.39	4.211	9.87	475	1118.62	4.794	9.59	535	1423.36	5.361	9.29
416	852.61	4.220	9.86	476	1123.42	4.804	9.58	536	1428.73	5.370	9.29
417	856.83	4.230	9.86	477	1128.23	4.813	9.58	537	1434.10	5.379	9.28
418	861.07	4.240	9.85	478	1133.05	4.823	9.57	538	1439.49	5.389	9.28
419	865.31	4.250	9.85	479	1137.87	4.833	9.57	539	1444.88	5.398	9.27
420	869.57	4.260	9.85	480	1142.71	4.842	9.56	540	1450.28	5.407	9.27

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	1450.28	5.407	9.27	600	1791.21	5.954	8.96	660	2164.37	6.482	8.64
541	1455.69	5.416	9.26	601	1797.17	5.963	8.95	661	2170.86	6.490	8.63
542	1461.12	5.426	9.26	602	1803.13	5.972	8.95	662	2177.35	6.499	8.63
543	1466.55	5.435	9.25	603	1809.11	5.981	8.94	663	2183.85	6.508	8.62
544	1471.99	5.444	9.25	604	1815.09	5.990	8.93	664	2190.37	6.516	8.62
545	1477.43	5.453	9.24	605	1821.09	5.999	8.93	665	2196.89	6.525	8.61
546	1482.89	5.463	9.24	606	1827.09	6.008	8.92	666	2203.41	6.533	8.61
547	1488.36	5.472	9.23	607	1833.10	6.016	8.92	667	2209.95	6.542	8.60
548	1493.84	5.481	9.23	608	1839.12	6.025	8.91	668	2216.50	6.551	8.60
549	1499.32	5.490	9.22	609	1845.15	6.034	8.91	669	2223.05	6.559	8.59
550	1504.82	5.500	9.21	610	1851.19	6.043	8.90	670	2229.62	6.568	8.59
551	1510.32	5.509	9.21	611	1857.24	6.052	8.90	671	2236.19	6.576	8.58
552	1515.83	5.518	9.20	612	1863.30	6.061	8.89	672	2242.77	6.585	8.57
553	1521.36	5.527	9.20	613	1869.36	6.070	8.89	673	2249.36	6.594	8.57
554	1526.89	5.536	9.19	614	1875.44	6.079	8.88	674	2255.96	6.602	8.56
555	1532.43	5.546	9.19	615	1881.52	6.088	8.88	675	2262.56	6.611	8.56
556	1537.98	5.555	9.18	616	1887.61	6.096	8.87	676	2269.18	6.619	8.55
557	1543.54	5.564	9.18	617	1893.71	6.105	8.87	677	2275.80	6.628	8.55
558	1549.11	5.573	9.17	618	1899.82	6.114	8.86	678	2282.43	6.636	8.54
559	1554.69	5.582	9.17	619	1905.94	6.123	8.86	679	2289.07	6.645	8.54
560	1560.27	5.591	9.16	620	1912.07	6.132	8.85	680	2295.72	6.653	8.53
561	1565.87	5.601	9.16	621	1918.20	6.141	8.84	681	2302.38	6.662	8.53
562	1571.47	5.610	9.15	622	1924.35	6.150	8.84	682	2309.05	6.670	8.52
563	1577.09	5.619	9.15	623	1930.50	6.158	8.83	683	2315.72	6.679	8.52
564	1582.71	5.628	9.14	624	1936.67	6.167	8.83	684	2322.41	6.687	8.51
565	1588.34	5.637	9.14	625	1942.84	6.176	8.82	685	2329.10	6.696	8.51
566	1593.99	5.646	9.13	626	1949.02	6.185	8.82	686	2335.80	6.705	8.50
567	1599.64	5.655	9.13	627	1955.21	6.194	8.81	687	2342.51	6.713	8.49
568	1605.30	5.665	9.12	628	1961.41	6.203	8.81	688	2349.22	6.721	8.49
569	1610.97	5.674	9.12	629	1967.61	6.211	8.80	689	2355.95	6.730	8.48
570	1616.64	5.683	9.11	630	1973.83	6.220	8.80	690	2362.68	6.738	8.48
571	1622.33	5.692	9.11	631	1980.05	6.229	8.79	691	2369.43	6.747	8.47
572	1628.03	5.701	9.10	632	1986.29	6.238	8.79	692	2376.18	6.755	8.47
573	1633.73	5.710	9.10	633	1992.53	6.247	8.78	693	2382.94	6.764	8.46
574	1639.45	5.719	9.09	634	1998.78	6.255	8.78	694	2389.71	6.772	8.46
575	1645.17	5.728	9.09	635	2005.04	6.264	8.77	695	2396.48	6.781	8.45
576	1650.91	5.737	9.08	636	2011.31	6.273	8.77	696	2403.27	6.789	8.45
577	1656.65	5.747	9.08	637	2017.59	6.282	8.76	697	2410.06	6.798	8.44
578	1662.40	5.756	9.07	638	2023.87	6.290	8.76	698	2416.86	6.806	8.44
579	1668.16	5.765	9.07	639	2030.17	6.299	8.75	699	2423.67	6.815	8.43
580	1673.93	5.774	9.06	640	2036.47	6.308	8.74	700	2430.49	6.823	8.43
581	1679.71	5.783	9.05	641	2042.78	6.317	8.74	701	2437.32	6.831	8.42
582	1685.49	5.792	9.05	642	2049.10	6.325	8.73	702	2444.15	6.840	8.41
583	1691.29	5.801	9.04	643	2055.43	6.334	8.73	703	2451.00	6.848	8.41
584	1697.09	5.810	9.04	644	2061.77	6.343	8.72	704	2457.85	6.857	8.40
585	1702.91	5.819	9.03	645	2068.12	6.352	8.72	705	2464.71	6.865	8.40
586	1708.73	5.828	9.03	646	2074.47	6.360	8.71	706	2471.58	6.873	8.39
587	1714.57	5.837	9.02	647	2080.84	6.369	8.71	707	2478.46	6.882	8.39
588	1720.41	5.846	9.02	648	2087.21	6.378	8.70	708	2485.34	6.890	8.38
589	1726.26	5.855	9.01	649	2093.59	6.386	8.70	709	2492.24	6.899	8.38
590	1732.12	5.864	9.01	650	2099.99	6.395	8.69	710	2499.14	6.907	8.37
591	1737.99	5.873	9.00	651	2106.38	6.404	8.69	711	2506.05	6.915	8.37
592	1743.86	5.882	9.00	652	2112.79	6.412	8.68	712	2512.97	6.924	8.36
593	1749.75	5.891	8.99	653	2119.21	6.421	8.68	713	2519.90	6.932	8.36
594	1755.65	5.900	8.99	654	2125.63	6.430	8.67	714	2526.84	6.940	8.35
595	1761.55	5.909	8.98	655	2132.07	6.438	8.66	715	2533.78	6.949	8.35
596	1767.46	5.918	8.98	656	2138.51	6.447	8.66	716	2540.73	6.957	8.34
597	1773.39	5.927	8.97	657	2144.96	6.456	8.65	717	2547.70	6.965	8.33
598	1779.32	5.936	8.97	658	2151.42	6.464	8.65	718	2554.66	6.974	8.33
599	1785.26	5.945	8.96	659	2157.89	6.473	8.64	719	2561.64	6.982	8.32
600	1791.21	5.954	8.96	660	2164.37	6.482	8.64	720	2568.63	6.990	8.32

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	2568.63	6.990	8.32	780	3002.84	7.480	8.00	840	3465.84	7.950	7.68
721	2575.62	6.999	8.31	781	3010.32	7.488	7.99	841	3473.80	7.958	7.68
722	2582.63	7.007	8.31	782	3017.81	7.496	7.99	842	3481.76	7.966	7.67
723	2589.64	7.015	8.30	783	3025.31	7.504	7.98	843	3489.73	7.973	7.67
724	2596.66	7.024	8.30	784	3032.82	7.512	7.98	844	3497.71	7.981	7.66
725	2603.68	7.032	8.29	785	3040.34	7.520	7.97	845	3505.69	7.989	7.66
726	2610.72	7.040	8.29	786	3047.86	7.528	7.97	846	3513.69	7.996	7.65
727	2617.77	7.049	8.28	787	3055.39	7.536	7.96	847	3521.69	8.004	7.65
728	2624.82	7.057	8.28	788	3062.93	7.544	7.96	848	3529.69	8.012	7.64
729	2631.88	7.065	8.27	789	3070.48	7.552	7.95	849	3537.71	8.019	7.64
730	2638.95	7.073	8.27	790	3078.04	7.560	7.95	850	3545.73	8.027	7.63
731	2646.03	7.082	8.26	791	3085.60	7.568	7.94	851	3553.76	8.035	7.62
732	2653.11	7.090	8.25	792	3093.17	7.576	7.94	852	3561.80	8.042	7.62
733	2660.21	7.098	8.25	793	3100.75	7.584	7.93	853	3569.85	8.050	7.61
734	2667.31	7.106	8.24	794	3108.34	7.591	7.93	854	3577.90	8.058	7.61
735	2674.42	7.115	8.24	795	3115.93	7.599	7.92	855	3585.96	8.065	7.60
736	2681.54	7.123	8.23	796	3123.54	7.607	7.92	856	3594.03	8.073	7.60
737	2688.66	7.131	8.23	797	3131.15	7.615	7.91	857	3602.11	8.080	7.59
738	2695.80	7.139	8.22	798	3138.77	7.623	7.90	858	3610.19	8.088	7.59
739	2702.94	7.148	8.22	799	3146.39	7.631	7.90	859	3618.28	8.095	7.58
740	2710.09	7.156	8.21	800	3154.03	7.639	7.89	860	3626.38	8.103	7.58
741	2717.25	7.164	8.21	801	3161.67	7.647	7.89	861	3634.49	8.111	7.57
742	2724.42	7.172	8.20	802	3169.32	7.655	7.88	862	3642.60	8.118	7.57
743	2731.60	7.180	8.20	803	3176.98	7.663	7.88	863	3650.73	8.126	7.56
744	2738.78	7.189	8.19	804	3184.65	7.670	7.87	864	3658.86	8.133	7.56
745	2745.98	7.197	8.19	805	3192.32	7.678	7.87	865	3666.99	8.141	7.55
746	2753.18	7.205	8.18	806	3200.00	7.686	7.86	866	3675.14	8.148	7.55
747	2760.38	7.213	8.18	807	3207.69	7.694	7.86	867	3683.29	8.156	7.54
748	2767.60	7.221	8.17	808	3215.39	7.702	7.85	868	3691.45	8.164	7.54
749	2774.83	7.229	8.16	809	3223.10	7.710	7.85	869	3699.62	8.171	7.53
750	2782.06	7.238	8.16	810	3230.81	7.718	7.84	870	3707.79	8.179	7.52
751	2789.30	7.246	8.15	811	3238.53	7.725	7.84	871	3715.97	8.186	7.52
752	2796.55	7.254	8.15	812	3246.26	7.733	7.83	872	3724.16	8.194	7.51
753	2803.81	7.262	8.14	813	3254.00	7.741	7.83	873	3732.36	8.201	7.51
754	2811.08	7.270	8.14	814	3261.74	7.749	7.82	874	3740.57	8.209	7.50
755	2818.35	7.278	8.13	815	3269.50	7.757	7.82	875	3748.78	8.216	7.50
756	2825.63	7.286	8.13	816	3277.26	7.765	7.81	876	3757.00	8.224	7.49
757	2832.92	7.295	8.12	817	3285.03	7.772	7.80	877	3765.23	8.231	7.49
758	2840.22	7.303	8.12	818	3292.80	7.780	7.80	878	3773.46	8.239	7.48
759	2847.53	7.311	8.11	819	3300.59	7.788	7.79	879	3781.70	8.246	7.48
760	2854.84	7.319	8.11	820	3308.38	7.796	7.79	880	3789.95	8.254	7.47
761	2862.17	7.327	8.10	821	3316.18	7.804	7.78	881	3798.21	8.261	7.47
762	2869.50	7.335	8.10	822	3323.99	7.811	7.78	882	3806.48	8.268	7.46
763	2876.84	7.343	8.09	823	3331.80	7.819	7.77	883	3814.75	8.276	7.46
764	2884.18	7.351	8.08	824	3339.62	7.827	7.77	884	3823.03	8.283	7.45
765	2891.54	7.359	8.08	825	3347.46	7.835	7.76	885	3831.31	8.291	7.45
766	2898.90	7.367	8.07	826	3355.29	7.842	7.76	886	3839.61	8.298	7.44
767	2906.27	7.376	8.07	827	3363.14	7.850	7.75	887	3847.91	8.306	7.43
768	2913.65	7.384	8.06	828	3370.99	7.858	7.75	888	3856.22	8.313	7.43
769	2921.04	7.392	8.06	829	3378.86	7.866	7.74	889	3864.54	8.321	7.42
770	2928.44	7.400	8.05	830	3386.73	7.873	7.74	890	3872.86	8.328	7.42
771	2935.84	7.408	8.05	831	3394.60	7.881	7.73	891	3881.19	8.335	7.41
772	2943.25	7.416	8.04	832	3402.49	7.889	7.73	892	3889.53	8.343	7.41
773	2950.67	7.424	8.04	833	3410.38	7.897	7.72	893	3897.88	8.350	7.40
774	2958.10	7.432	8.03	834	3418.28	7.904	7.71	894	3906.23	8.358	7.40
775	2965.54	7.440	8.03	835	3426.19	7.912	7.71	895	3914.59	8.365	7.39
776	2972.98	7.448	8.02	836	3434.10	7.920	7.70	896	3922.96	8.372	7.39
777	2980.43	7.456	8.02	837	3442.03	7.927	7.70	897	3931.34	8.380	7.38
778	2987.89	7.464	8.01	838	3449.96	7.935	7.69	898	3939.72	8.387	7.38
779	2995.36	7.472	8.01	839	3457.90	7.943	7.69	899	3948.11	8.395	7.37
780	3002.84	7.480	8.00	840	3465.84	7.950	7.68	900	3956.51	8.402	7.37

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	3956.51	8.402	7.37	960	4473.69	8.834	7.04	1020	5016.22	9.247	6.71
901	3964.92	8.409	7.36	961	4482.53	8.841	7.04	1021	5025.47	9.253	6.70
902	3973.33	8.417	7.35	962	4491.38	8.848	7.03	1022	5034.73	9.260	6.69
903	3981.75	8.424	7.35	963	4500.23	8.855	7.03	1023	5044.00	9.267	6.69
904	3990.18	8.431	7.34	964	4509.09	8.862	7.02	1024	5053.27	9.274	6.68
905	3998.61	8.439	7.34	965	4517.95	8.869	7.02	1025	5062.54	9.280	6.68
906	4007.06	8.446	7.33	966	4526.83	8.876	7.01	1026	5071.83	9.287	6.67
907	4015.51	8.453	7.33	967	4535.71	8.883	7.00	1027	5081.12	9.294	6.67
908	4023.96	8.461	7.32	968	4544.59	8.890	7.00	1028	5090.41	9.300	6.66
909	4032.43	8.468	7.32	969	4553.49	8.897	6.99	1029	5099.72	9.307	6.65
910	4040.90	8.475	7.31	970	4562.39	8.904	6.99	1030	5109.03	9.314	6.65
911	4049.38	8.483	7.31	971	4571.30	8.911	6.98	1031	5118.34	9.320	6.64
912	4057.86	8.490	7.30	972	4580.21	8.918	6.98	1032	5127.67	9.327	6.64
913	4066.36	8.497	7.30	973	4589.13	8.925	6.97	1033	5137.00	9.333	6.63
914	4074.86	8.505	7.29	974	4598.06	8.932	6.97	1034	5146.33	9.340	6.63
915	4083.37	8.512	7.29	975	4607.00	8.939	6.96	1035	5155.68	9.347	6.62
916	4091.88	8.519	7.28	976	4615.94	8.946	6.95	1036	5165.03	9.353	6.61
917	4100.40	8.526	7.27	977	4624.89	8.953	6.95	1037	5174.38	9.360	6.61
918	4108.93	8.534	7.27	978	4633.85	8.960	6.94	1038	5183.75	9.367	6.60
919	4117.47	8.541	7.26	979	4642.81	8.967	6.94	1039	5193.12	9.373	6.60
920	4126.02	8.548	7.26	980	4651.78	8.974	6.93	1040	5202.49	9.380	6.59
921	4134.57	8.555	7.25	981	4660.76	8.981	6.93	1041	5211.88	9.386	6.58
922	4143.13	8.563	7.25	982	4669.74	8.988	6.92	1042	5221.27	9.393	6.58
923	4151.69	8.570	7.24	983	4678.73	8.995	6.92	1043	5230.66	9.399	6.57
924	4160.27	8.577	7.24	984	4687.73	9.002	6.91	1044	5240.07	9.406	6.57
925	4168.85	8.584	7.23	985	4696.74	9.009	6.90	1045	5249.47	9.413	6.56
926	4177.44	8.592	7.23	986	4705.75	9.015	6.90	1046	5258.89	9.419	6.55
927	4186.03	8.599	7.22	987	4714.77	9.022	6.89	1047	5268.31	9.426	6.55
928	4194.63	8.606	7.22	988	4723.79	9.029	6.89	1048	5277.74	9.432	6.54
929	4203.24	8.613	7.21	989	4732.83	9.036	6.88	1049	5287.18	9.439	6.54
930	4211.86	8.621	7.21	990	4741.86	9.043	6.88	1050	5296.62	9.445	6.53
931	4220.48	8.628	7.20	991	4750.91	9.050	6.87	1051	5306.07	9.452	6.52
932	4229.12	8.635	7.19	992	4759.96	9.057	6.87	1052	5315.52	9.458	6.52
933	4237.75	8.642	7.19	993	4769.02	9.064	6.86	1053	5324.99	9.465	6.51
934	4246.40	8.649	7.18	994	4778.09	9.070	6.85	1054	5334.45	9.471	6.51
935	4255.05	8.656	7.18	995	4787.17	9.077	6.85	1055	5343.93	9.478	6.50
936	4263.71	8.664	7.17	996	4796.25	9.084	6.84	1056	5353.41	9.484	6.49
937	4272.38	8.671	7.17	997	4805.33	9.091	6.84	1057	5362.90	9.491	6.49
938	4281.05	8.678	7.16	998	4814.43	9.098	6.83	1058	5372.39	9.497	6.48
939	4289.74	8.685	7.16	999	4823.53	9.105	6.83	1059	5381.89	9.504	6.48
940	4298.43	8.692	7.15	1000	4832.64	9.112	6.82	1060	5391.40	9.510	6.47
941	4307.12	8.699	7.15	1001	4841.75	9.118	6.81	1061	5400.91	9.517	6.46
942	4315.82	8.707	7.14	1002	4850.87	9.125	6.81	1062	5410.43	9.523	6.46
943	4324.53	8.714	7.14	1003	4860.00	9.132	6.80	1063	5419.96	9.530	6.45
944	4333.25	8.721	7.13	1004	4869.14	9.139	6.80	1064	5429.49	9.536	6.45
945	4341.98	8.728	7.12	1005	4878.28	9.146	6.79	1065	5439.03	9.543	6.44
946	4350.71	8.735	7.12	1006	4887.43	9.152	6.79	1066	5448.58	9.549	6.43
947	4359.45	8.742	7.11	1007	4896.59	9.159	6.78	1067	5458.13	9.555	6.43
948	4368.19	8.749	7.11	1008	4905.75	9.166	6.78	1068	5467.69	9.562	6.42
949	4376.94	8.756	7.10	1009	4914.92	9.173	6.77	1069	5477.25	9.568	6.41
950	4385.70	8.764	7.10	1010	4924.09	9.179	6.76	1070	5486.82	9.575	6.41
951	4394.47	8.771	7.09	1011	4933.28	9.186	6.76	1071	5496.40	9.581	6.40
952	4403.25	8.778	7.09	1012	4942.47	9.193	6.75	1072	5505.99	9.588	6.40
953	4412.03	8.785	7.08	1013	4951.66	9.200	6.75	1073	5515.58	9.594	6.39
954	4420.82	8.792	7.08	1014	4960.86	9.206	6.74	1074	5525.18	9.600	6.38
955	4429.61	8.799	7.07	1015	4970.07	9.213	6.74	1075	5534.78	9.607	6.38
956	4438.41	8.806	7.06	1016	4979.29	9.220	6.73	1076	5544.39	9.613	6.37
957	4447.22	8.813	7.06	1017	4988.51	9.227	6.72	1077	5554.00	9.619	6.37
958	4456.04	8.820	7.05	1018	4997.74	9.233	6.72	1078	5563.63	9.626	6.36
959	4464.86	8.827	7.05	1019	5006.98	9.240	6.71	1079	5573.26	9.632	6.35
960	4473.69	8.834	7.04	1020	5016.22	9.247	6.71	1080	5582.89	9.639	6.35

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1080	5582.89	9.639	6.35	1140	6172.40	10.008	5.95	1200	6783.31	10.352	5.51
1081	5592.53	9.645	6.34	1141	6182.41	10.014	5.94	1201	6793.66	10.357	5.50
1082	5602.18	9.651	6.33	1142	6192.42	10.020	5.94	1202	6804.02	10.363	5.49
1083	5611.84	9.658	6.33	1143	6202.45	10.025	5.93	1203	6814.39	10.368	5.48
1084	5621.50	9.664	6.32	1144	6212.47	10.031	5.92	1204	6824.76	10.374	5.47
1085	5631.16	9.670	6.32	1145	6222.51	10.037	5.92	1205	6835.14	10.379	5.47
1086	5640.84	9.676	6.31	1146	6232.55	10.043	5.91	1206	6845.52	10.385	5.46
1087	5650.52	9.683	6.30	1147	6242.60	10.049	5.90	1207	6855.91	10.390	5.45
1088	5660.20	9.689	6.30	1148	6252.65	10.055	5.89	1208	6866.30	10.395	5.44
1089	5669.89	9.695	6.29	1149	6262.71	10.061	5.89	1209	6876.70	10.401	5.43
1090	5679.59	9.702	6.28	1150	6272.77	10.067	5.88	1210	6887.10	10.406	5.43
1091	5689.30	9.708	6.28	1151	6282.84	10.073	5.87	1211	6897.51	10.412	5.42
1092	5699.01	9.714	6.27	1152	6292.91	10.079	5.87	1212	6907.92	10.417	5.41
1093	5708.73	9.720	6.26	1153	6303.00	10.084	5.86	1213	6918.34	10.423	5.40
1094	5718.45	9.727	6.26	1154	6313.08	10.090	5.85	1214	6928.77	10.428	5.39
1095	5728.18	9.733	6.25	1155	6323.18	10.096	5.85	1215	6939.20	10.433	5.39
1096	5737.92	9.739	6.25	1156	6333.28	10.102	5.84	1216	6949.64	10.439	5.38
1097	5747.66	9.746	6.24	1157	6343.38	10.108	5.83	1217	6960.08	10.444	5.37
1098	5757.41	9.752	6.23	1158	6353.49	10.114	5.82	1218	6970.52	10.449	5.36
1099	5767.16	9.758	6.23	1159	6363.61	10.119	5.82	1219	6980.98	10.455	5.35
1100	5776.92	9.764	6.22	1160	6373.73	10.125	5.81	1220	6991.43	10.460	5.34
1101	5786.69	9.770	6.21	1161	6383.86	10.131	5.80	1221	7001.90	10.466	5.34
1102	5796.46	9.777	6.21	1162	6393.99	10.137	5.79	1222	7012.36	10.471	5.33
1103	5806.24	9.783	6.20	1163	6404.13	10.143	5.79	1223	7022.84	10.476	5.32
1104	5816.03	9.789	6.19	1164	6414.28	10.148	5.78	1224	7033.32	10.481	5.31
1105	5825.82	9.795	6.19	1165	6424.43	10.154	5.77	1225	7043.80	10.487	5.30
1106	5835.62	9.801	6.18	1166	6434.59	10.160	5.77	1226	7054.29	10.492	5.29
1107	5845.42	9.808	6.17	1167	6444.75	10.166	5.76	1227	7064.79	10.497	5.29
1108	5855.24	9.814	6.17	1168	6454.92	10.172	5.75	1228	7075.29	10.503	5.28
1109	5865.05	9.820	6.16	1169	6465.09	10.177	5.74	1229	7085.79	10.508	5.27
1110	5874.87	9.826	6.15	1170	6475.27	10.183	5.74	1230	7096.30	10.513	5.26
1111	5884.70	9.832	6.15	1171	6485.46	10.189	5.73	1231	7106.82	10.518	5.25
1112	5894.54	9.838	6.14	1172	6495.65	10.194	5.72	1232	7117.34	10.524	5.24
1113	5904.38	9.844	6.13	1173	6505.85	10.200	5.71	1233	7127.86	10.529	5.24
1114	5914.23	9.851	6.13	1174	6516.05	10.206	5.71	1234	7138.40	10.534	5.23
1115	5924.08	9.857	6.12	1175	6526.26	10.212	5.70	1235	7148.93	10.539	5.22
1116	5933.94	9.863	6.11	1176	6536.47	10.217	5.69	1236	7159.48	10.545	5.21
1117	5943.81	9.869	6.11	1177	6546.69	10.223	5.68	1237	7170.02	10.550	5.20
1118	5953.68	9.875	6.10	1178	6556.92	10.229	5.68	1238	7180.57	10.555	5.19
1119	5963.56	9.881	6.09	1179	6567.15	10.234	5.67	1239	7191.13	10.560	5.18
1120	5973.44	9.887	6.09	1180	6577.39	10.240	5.66	1240	7201.70	10.565	5.18
1121	5983.33	9.893	6.08	1181	6587.63	10.246	5.65	1241	7212.26	10.571	5.17
1122	5993.23	9.899	6.07	1182	6597.88	10.251	5.65	1242	7222.84	10.576	5.16
1123	6003.13	9.906	6.07	1183	6608.13	10.257	5.64	1243	7233.41	10.581	5.15
1124	6013.04	9.912	6.06	1184	6618.39	10.263	5.63	1244	7244.00	10.586	5.14
1125	6022.95	9.918	6.05	1185	6628.66	10.268	5.62	1245	7254.59	10.591	5.13
1126	6032.88	9.924	6.05	1186	6638.93	10.274	5.62	1246	7265.18	10.596	5.12
1127	6042.80	9.930	6.04	1187	6649.21	10.279	5.61	1247	7275.78	10.601	5.11
1128	6052.73	9.936	6.03	1188	6659.49	10.285	5.60	1248	7286.38	10.607	5.11
1129	6062.67	9.942	6.03	1189	6669.78	10.291	5.59	1249	7296.99	10.612	5.10
1130	6072.62	9.948	6.02	1190	6680.07	10.296	5.58	1250	7307.61	10.617	5.09
1131	6082.57	9.954	6.01	1191	6690.37	10.302	5.58	1251	7318.23	10.622	5.08
1132	6092.53	9.960	6.01	1192	6700.67	10.307	5.57	1252	7328.85	10.627	5.07
1133	6102.49	9.966	6.00	1193	6710.98	10.313	5.56	1253	7339.48	10.632	5.06
1134	6112.46	9.972	5.99	1194	6721.30	10.318	5.55	1254	7350.11	10.637	5.05
1135	6122.43	9.978	5.99	1195	6731.62	10.324	5.55	1255	7360.75	10.642	5.04
1136	6132.41	9.984	5.98	1196	6741.95	10.330	5.54	1256	7371.40	10.647	5.03
1137	6142.40	9.990	5.97	1197	6752.28	10.335	5.53	1257	7382.05	10.652	5.03
1138	6152.39	9.996	5.97	1198	6762.62	10.341	5.52	1258	7392.70	10.657	5.02
1139	6162.39	10.002	5.96	1199	6772.96	10.346	5.51	1259	7403.36	10.662	5.01
1140	6172.40	10.008	5.95	1200	6783.31	10.352	5.51	1260	7414.03	10.667	5.00

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1260	7414.03	10.667	5.00	1320	8062.71	10.950	4.41	1380	8727.27	11.195	3.75
1261	7424.70	10.672	4.99	1321	8073.67	10.954	4.40	1381	8738.47	11.199	3.73
1262	7435.37	10.677	4.98	1322	8084.62	10.959	4.39	1382	8749.67	11.203	3.72
1263	7446.05	10.682	4.97	1323	8095.58	10.963	4.38	1383	8760.87	11.206	3.71
1264	7456.74	10.687	4.96	1324	8106.55	10.968	4.37	1384	8772.08	11.210	3.70
1265	7467.42	10.692	4.95	1325	8117.52	10.972	4.36	1385	8783.29	11.214	3.69
1266	7478.12	10.697	4.94	1326	8128.49	10.976	4.35	1386	8794.51	11.217	3.67
1267	7488.82	10.702	4.93	1327	8139.47	10.981	4.34	1387	8805.73	11.221	3.66
1268	7499.52	10.707	4.92	1328	8150.45	10.985	4.33	1388	8816.95	11.225	3.65
1269	7510.23	10.712	4.92	1329	8161.44	10.989	4.32	1389	8828.18	11.228	3.64
1270	7520.95	10.717	4.91	1330	8172.43	10.994	4.31	1390	8839.41	11.232	3.63
1271	7531.67	10.722	4.90	1331	8183.43	10.998	4.30	1391	8850.64	11.236	3.61
1272	7542.39	10.726	4.89	1332	8194.43	11.002	4.29	1392	8861.88	11.239	3.60
1273	7553.12	10.731	4.88	1333	8205.43	11.006	4.28	1393	8873.12	11.243	3.59
1274	7563.85	10.736	4.87	1334	8216.44	11.011	4.27	1394	8884.36	11.246	3.58
1275	7574.59	10.741	4.86	1335	8227.45	11.015	4.26	1395	8895.61	11.250	3.57
1276	7585.33	10.746	4.85	1336	8238.47	11.019	4.25	1396	8906.86	11.254	3.55
1277	7596.08	10.751	4.84	1337	8249.49	11.023	4.23	1397	8918.12	11.257	3.54
1278	7606.84	10.756	4.83	1338	8260.52	11.028	4.22	1398	8929.38	11.261	3.53
1279	7617.59	10.760	4.82	1339	8271.55	11.032	4.21	1399	8940.64	11.264	3.52
1280	7628.36	10.765	4.81	1340	8282.58	11.036	4.20	1400	8951.91	11.268	3.50
1281	7639.12	10.770	4.80	1341	8293.62	11.040	4.19	1401	8963.18	11.271	3.49
1282	7649.90	10.775	4.79	1342	8304.66	11.045	4.18	1402	8974.45	11.275	3.48
1283	7660.67	10.780	4.78	1343	8315.71	11.049	4.17	1403	8985.73	11.278	3.47
1284	7671.46	10.784	4.77	1344	8326.76	11.053	4.16	1404	8997.01	11.282	3.45
1285	7682.24	10.789	4.76	1345	8337.81	11.057	4.15	1405	9008.29	11.285	3.44
1286	7693.03	10.794	4.76	1346	8348.87	11.061	4.14	1406	9019.58	11.289	3.43
1287	7703.83	10.799	4.75	1347	8359.94	11.065	4.12	1407	9030.87	11.292	3.42
1288	7714.63	10.803	4.74	1348	8371.00	11.069	4.11	1408	9042.16	11.295	3.40
1289	7725.44	10.808	4.73	1349	8382.08	11.073	4.10	1409	9053.46	11.299	3.39
1290	7736.25	10.813	4.72	1350	8393.15	11.078	4.09	1410	9064.76	11.302	3.38
1291	7747.06	10.818	4.71	1351	8404.23	11.082	4.08	1411	9076.06	11.306	3.37
1292	7757.88	10.822	4.70	1352	8415.31	11.086	4.07	1412	9087.37	11.309	3.35
1293	7768.71	10.827	4.69	1353	8426.40	11.090	4.06	1413	9098.68	11.312	3.34
1294	7779.54	10.832	4.68	1354	8437.49	11.094	4.05	1414	9109.99	11.316	3.33
1295	7790.37	10.836	4.67	1355	8448.59	11.098	4.04	1415	9121.31	11.319	3.32
1296	7801.21	10.841	4.66	1356	8459.69	11.102	4.02	1416	9132.63	11.322	3.30
1297	7812.05	10.846	4.65	1357	8470.79	11.106	4.01	1417	9143.95	11.325	3.29
1298	7822.90	10.850	4.64	1358	8481.90	11.110	4.00	1418	9155.28	11.329	3.28
1299	7833.75	10.855	4.63	1359	8493.01	11.114	3.99	1419	9166.61	11.332	3.26
1300	7844.61	10.860	4.62	1360	8504.13	11.118	3.98	1420	9177.95	11.335	3.25
1301	7855.47	10.864	4.61	1361	8515.25	11.122	3.97	1421	9189.28	11.339	3.24
1302	7866.34	10.869	4.60	1362	8526.37	11.126	3.96	1422	9200.62	11.342	3.23
1303	7877.21	10.873	4.59	1363	8537.50	11.130	3.94	1423	9211.97	11.345	3.21
1304	7888.09	10.878	4.58	1364	8548.63	11.134	3.93	1424	9223.31	11.348	3.20
1305	7898.97	10.883	4.57	1365	8559.77	11.138	3.92	1425	9234.66	11.351	3.19
1306	7909.85	10.887	4.56	1366	8570.91	11.142	3.91	1426	9246.02	11.355	3.17
1307	7920.74	10.892	4.55	1367	8582.05	11.146	3.90	1427	9257.37	11.358	3.16
1308	7931.64	10.896	4.54	1368	8593.20	11.149	3.89	1428	9268.73	11.361	3.15
1309	7942.53	10.901	4.53	1369	8604.35	11.153	3.88	1429	9280.09	11.364	3.13
1310	7953.44	10.905	4.52	1370	8615.51	11.157	3.86	1430	9291.46	11.367	3.12
1311	7964.34	10.910	4.51	1371	8626.67	11.161	3.85	1431	9302.83	11.370	3.11
1312	7975.26	10.914	4.50	1372	8637.83	11.165	3.84	1432	9314.20	11.373	3.09
1313	7986.17	10.919	4.49	1373	8648.99	11.169	3.83	1433	9325.57	11.376	3.08
1314	7997.09	10.923	4.48	1374	8660.17	11.173	3.82	1434	9336.95	11.380	3.07
1315	8008.02	10.928	4.47	1375	8671.34	11.176	3.81	1435	9348.33	11.383	3.05
1316	8018.95	10.932	4.46	1376	8682.52	11.180	3.79	1436	9359.72	11.386	3.04
1317	8029.88	10.937	4.45	1377	8693.70	11.184	3.78	1437	9371.10	11.389	3.03
1318	8040.82	10.941	4.44	1378	8704.89	11.188	3.77	1438	9382.49	11.392	3.01
1319	8051.77	10.946	4.43	1379	8716.08	11.191	3.76	1439	9393.89	11.395	3.00
1320	8062.71	10.950	4.41	1380	8727.27	11.195	3.75	1440	9405.28	11.398	2.99

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1440	9405.28	11.398	2.99	1500	10094.03	11.552	2.14	1560	10790.46	11.653	1.22
1441	9416.68	11.401	2.97	1501	10105.58	11.554	2.13	1561	10802.11	11.654	1.20
1442	9428.09	11.404	2.96	1502	10117.14	11.556	2.11	1562	10813.77	11.655	1.18
1443	9439.49	11.407	2.95	1503	10128.69	11.558	2.10	1563	10825.42	11.657	1.17
1444	9450.90	11.410	2.93	1504	10140.25	11.560	2.08	1564	10837.08	11.658	1.15
1445	9462.31	11.412	2.92	1505	10151.82	11.563	2.07	1565	10848.74	11.659	1.14
1446	9473.72	11.415	2.91	1506	10163.38	11.565	2.05	1566	10860.40	11.660	1.12
1447	9485.14	11.418	2.89	1507	10174.94	11.567	2.04	1567	10872.06	11.661	1.10
1448	9496.56	11.421	2.88	1508	10186.51	11.569	2.02	1568	10883.72	11.662	1.09
1449	9507.98	11.424	2.87	1509	10198.08	11.571	2.01	1569	10895.38	11.663	1.07
1450	9519.41	11.427	2.85	1510	10209.65	11.573	1.99	1570	10907.05	11.664	1.06
1451	9530.84	11.430	2.84	1511	10221.23	11.575	1.98	1571	10918.71	11.666	1.04
1452	9542.27	11.433	2.83	1512	10232.80	11.577	1.96	1572	10930.38	11.667	1.02
1453	9553.70	11.435	2.81	1513	10244.38	11.579	1.95	1573	10942.05	11.668	1.01
1454	9565.14	11.438	2.80	1514	10255.96	11.581	1.93	1574	10953.71	11.669	0.99
1455	9576.58	11.441	2.78	1515	10267.54	11.582	1.92	1575	10965.38	11.670	0.98
1456	9588.02	11.444	2.77	1516	10279.13	11.584	1.90	1576	10977.05	11.671	0.96
1457	9599.47	11.447	2.76	1517	10290.71	11.586	1.89	1577	10988.72	11.671	0.94
1458	9610.91	11.449	2.74	1518	10302.30	11.588	1.87	1578	11000.40	11.672	0.93
1459	9622.36	11.452	2.73	1519	10313.89	11.590	1.86	1579	11012.07	11.673	0.91
1460	9633.82	11.455	2.72	1520	10325.48	11.592	1.84	1580	11023.74	11.674	0.89
1461	9645.27	11.457	2.70	1521	10337.07	11.594	1.83	1581	11035.42	11.675	0.88
1462	9656.73	11.460	2.69	1522	10348.67	11.595	1.81	1582	11047.09	11.676	0.86
1463	9668.19	11.463	2.67	1523	10360.26	11.597	1.80	1583	11058.77	11.677	0.85
1464	9679.66	11.466	2.66	1524	10371.86	11.599	1.78	1584	11070.45	11.678	0.83
1465	9691.13	11.468	2.65	1525	10383.46	11.601	1.76	1585	11082.13	11.678	0.81
1466	9702.59	11.471	2.63	1526	10395.06	11.603	1.75	1586	11093.80	11.679	0.80
1467	9714.07	11.473	2.62	1527	10406.66	11.604	1.73	1587	11105.48	11.680	0.78
1468	9725.54	11.476	2.60	1528	10418.27	11.606	1.72	1588	11117.16	11.681	0.76
1469	9737.02	11.479	2.59	1529	10429.88	11.608	1.70	1589	11128.85	11.682	0.75
1470	9748.50	11.481	2.58	1530	10441.49	11.609	1.69	1590	11140.53	11.682	0.73
1471	9759.98	11.484	2.56	1531	10453.10	11.611	1.67	1591	11152.21	11.683	0.72
1472	9771.47	11.486	2.55	1532	10464.71	11.613	1.66	1592	11163.89	11.684	0.70
1473	9782.95	11.489	2.53	1533	10476.32	11.614	1.64	1593	11175.58	11.684	0.68
1474	9794.44	11.491	2.52	1534	10487.94	11.616	1.63	1594	11187.26	11.685	0.67
1475	9805.94	11.494	2.50	1535	10499.55	11.618	1.61	1595	11198.95	11.686	0.65
1476	9817.43	11.496	2.49	1536	10511.17	11.619	1.59	1596	11210.63	11.686	0.63
1477	9828.93	11.499	2.48	1537	10522.79	11.621	1.58	1597	11222.32	11.687	0.62
1478	9840.43	11.501	2.46	1538	10534.41	11.622	1.56	1598	11234.01	11.688	0.60
1479	9851.93	11.504	2.45	1539	10546.04	11.624	1.55	1599	11245.70	11.688	0.58
1480	9863.44	11.506	2.43	1540	10557.66	11.626	1.53	1600	11257.38	11.689	0.57
1481	9874.94	11.509	2.42	1541	10569.29	11.627	1.52	1601	11269.07	11.689	0.55
1482	9886.45	11.511	2.40	1542	10580.92	11.629	1.50	1602	11280.76	11.690	0.53
1483	9897.97	11.513	2.39	1543	10592.55	11.630	1.49	1603	11292.45	11.690	0.52
1484	9909.48	11.516	2.38	1544	10604.18	11.632	1.47	1604	11304.14	11.691	0.50
1485	9921.00	11.518	2.36	1545	10615.81	11.633	1.45	1605	11315.84	11.691	0.49
1486	9932.52	11.521	2.35	1546	10627.44	11.635	1.44	1606	11327.53	11.692	0.47
1487	9944.04	11.523	2.33	1547	10639.08	11.636	1.42	1607	11339.22	11.692	0.45
1488	9955.56	11.525	2.32	1548	10650.71	11.637	1.41	1608	11350.91	11.693	0.44
1489	9967.09	11.528	2.30	1549	10662.35	11.639	1.39	1609	11362.61	11.693	0.42
1490	9978.62	11.530	2.29	1550	10673.99	11.640	1.38	1610	11374.30	11.694	0.40
1491	9990.15	11.532	2.27	1551	10685.63	11.641	1.36	1611	11385.99	11.694	0.39
1492	10001.68	11.534	2.26	1552	10697.28	11.643	1.34	1612	11397.69	11.694	0.37
1493	10013.22	11.537	2.24	1553	10708.92	11.644	1.33	1613	11409.38	11.695	0.35
1494	10024.76	11.539	2.23	1554	10720.56	11.646	1.31	1614	11421.08	11.695	0.34
1495	10036.30	11.541	2.22	1555	10732.21	11.647	1.30	1615	11432.77	11.696	0.32
1496	10047.84	11.543	2.20	1556	10743.86	11.648	1.28	1616	11444.47	11.696	0.30
1497	10059.38	11.546	2.19	1557	10755.51	11.649	1.26	1617	11456.16	11.696	0.29
1498	10070.93	11.548	2.17	1558	10767.16	11.651	1.25	1618	11467.86	11.696	0.27
1499	10082.48	11.550	2.16	1559	10778.81	11.652	1.23	1619	11479.56	11.697	0.25
1500	10094.03	11.552	2.14	1560	10790.46	11.653	1.22	1620	11491.25	11.697	0.24

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1620	11491.25	11.697	0.24	1680	12192.89	11.681	-0.76	1740	12891.80	11.606	-1.73
1621	11502.95	11.697	0.22	1681	12204.57	11.680	-0.78	1741	12903.40	11.604	-1.74
1622	11514.65	11.697	0.20	1682	12216.25	11.680	-0.80	1742	12915.01	11.603	-1.76
1623	11526.35	11.698	0.19	1683	12227.93	11.679	-0.81	1743	12926.61	11.601	-1.77
1624	11538.04	11.698	0.17	1684	12239.61	11.678	-0.83	1744	12938.21	11.599	-1.79
1625	11549.74	11.698	0.15	1685	12251.29	11.677	-0.85	1745	12949.81	11.597	-1.80
1626	11561.44	11.698	0.14	1686	12262.97	11.676	-0.86	1746	12961.40	11.595	-1.82
1627	11573.14	11.698	0.12	1687	12274.64	11.675	-0.88	1747	12973.00	11.594	-1.83
1628	11584.83	11.698	0.10	1688	12286.32	11.674	-0.89	1748	12984.59	11.592	-1.85
1629	11596.53	11.698	0.09	1689	12297.99	11.674	-0.91	1749	12996.18	11.590	-1.86
1630	11608.23	11.698	0.07	1690	12309.66	11.673	-0.93	1750	13007.77	11.588	-1.88
1631	11619.93	11.698	0.05	1691	12321.34	11.672	-0.94	1751	13019.36	11.586	-1.89
1632	11631.63	11.699	0.04	1692	12333.01	11.671	-0.96	1752	13030.94	11.584	-1.91
1633	11643.33	11.699	0.02	1693	12344.68	11.670	-0.98	1753	13042.52	11.582	-1.92
1634	11655.03	11.699	0.00	1694	12356.35	11.669	-0.99	1754	13054.11	11.580	-1.94
1635	11666.72	11.699	-0.01	1695	12368.01	11.668	-1.01	1755	13065.68	11.578	-1.95
1636	11678.42	11.699	-0.03	1696	12379.68	11.667	-1.03	1756	13077.26	11.576	-1.97
1637	11690.12	11.699	-0.05	1697	12391.35	11.666	-1.04	1757	13088.84	11.574	-1.98
1638	11701.82	11.698	-0.06	1698	12403.01	11.665	-1.06	1758	13100.41	11.573	-2.00
1639	11713.52	11.698	-0.08	1699	12414.68	11.664	-1.07	1759	13111.98	11.570	-2.01
1640	11725.22	11.698	-0.10	1700	12426.34	11.663	-1.09	1760	13123.55	11.568	-2.03
1641	11736.91	11.698	-0.11	1701	12438.00	11.661	-1.11	1761	13135.12	11.566	-2.04
1642	11748.61	11.698	-0.13	1702	12449.66	11.660	-1.12	1762	13146.69	11.564	-2.06
1643	11760.31	11.698	-0.15	1703	12461.32	11.659	-1.14	1763	13158.25	11.562	-2.07
1644	11772.01	11.698	-0.16	1704	12472.98	11.658	-1.16	1764	13169.81	11.560	-2.09
1645	11783.71	11.698	-0.18	1705	12484.64	11.657	-1.17	1765	13181.37	11.558	-2.10
1646	11795.40	11.697	-0.20	1706	12496.30	11.656	-1.19	1766	13192.93	11.556	-2.12
1647	11807.10	11.697	-0.21	1707	12507.95	11.655	-1.20	1767	13204.48	11.554	-2.13
1648	11818.80	11.697	-0.23	1708	12519.60	11.653	-1.22	1768	13216.03	11.552	-2.15
1649	11830.50	11.697	-0.25	1709	12531.26	11.652	-1.24	1769	13227.58	11.550	-2.16
1650	11842.19	11.696	-0.26	1710	12542.91	11.651	-1.25	1770	13239.13	11.547	-2.17
1651	11853.89	11.696	-0.28	1711	12554.56	11.650	-1.27	1771	13250.68	11.545	-2.19
1652	11865.58	11.696	-0.30	1712	12566.21	11.648	-1.29	1772	13262.22	11.543	-2.20
1653	11877.28	11.696	-0.31	1713	12577.86	11.647	-1.30	1773	13273.77	11.541	-2.22
1654	11888.98	11.695	-0.33	1714	12589.50	11.646	-1.32	1774	13285.31	11.539	-2.23
1655	11900.67	11.695	-0.35	1715	12601.15	11.644	-1.33	1775	13296.84	11.536	-2.24
1656	11912.37	11.695	-0.36	1716	12612.79	11.643	-1.35	1776	13308.38	11.534	-2.26
1657	11924.06	11.694	-0.38	1717	12624.43	11.642	-1.37	1777	13319.91	11.532	-2.27
1658	11935.75	11.694	-0.40	1718	12636.07	11.640	-1.38	1778	13331.44	11.530	-2.29
1659	11947.45	11.693	-0.41	1719	12647.71	11.639	-1.40	1779	13342.97	11.527	-2.30
1660	11959.14	11.693	-0.43	1720	12659.35	11.637	-1.41	1780	13354.50	11.525	-2.31
1661	11970.83	11.693	-0.45	1721	12670.99	11.636	-1.43	1781	13366.02	11.523	-2.33
1662	11982.53	11.692	-0.46	1722	12682.62	11.635	-1.45	1782	13377.54	11.520	-2.34
1663	11994.22	11.692	-0.48	1723	12694.26	11.633	-1.46	1783	13389.06	11.518	-2.36
1664	12005.91	11.691	-0.50	1724	12705.89	11.632	-1.48	1784	13400.58	11.516	-2.37
1665	12017.60	11.691	-0.51	1725	12717.52	11.630	-1.49	1785	13412.09	11.513	-2.38
1666	12029.29	11.690	-0.53	1726	12729.15	11.629	-1.51	1786	13423.60	11.511	-2.40
1667	12040.98	11.690	-0.55	1727	12740.78	11.627	-1.52	1787	13435.11	11.508	-2.41
1668	12052.67	11.689	-0.56	1728	12752.40	11.626	-1.54	1788	13446.62	11.506	-2.42
1669	12064.36	11.688	-0.58	1729	12764.03	11.624	-1.56	1789	13458.13	11.504	-2.44
1670	12076.05	11.688	-0.60	1730	12775.65	11.623	-1.57	1790	13469.63	11.501	-2.45
1671	12087.73	11.687	-0.61	1731	12787.27	11.621	-1.59	1791	13481.13	11.499	-2.46
1672	12099.42	11.687	-0.63	1732	12798.89	11.619	-1.60	1792	13492.63	11.496	-2.48
1673	12111.11	11.686	-0.65	1733	12810.51	11.618	-1.62	1793	13504.12	11.494	-2.49
1674	12122.79	11.685	-0.66	1734	12822.13	11.616	-1.63	1794	13515.61	11.491	-2.50
1675	12134.48	11.685	-0.68	1735	12833.75	11.614	-1.65	1795	13527.10	11.489	-2.52
1676	12146.16	11.684	-0.70	1736	12845.36	11.613	-1.67	1796	13538.59	11.486	-2.53
1677	12157.85	11.683	-0.71	1737	12856.97	11.611	-1.68	1797	13550.08	11.484	-2.54
1678	12169.53	11.683	-0.73	1738	12868.58	11.609	-1.70	1798	13561.56	11.481	-2.56
1679	12181.21	11.682	-0.75	1739	12880.19	11.608	-1.71	1799	13573.04	11.479	-2.57
1680	12192.89	11.681	-0.76	1740	12891.80	11.606	-1.73	1800	13584.52	11.476	-2.58

TABLE 4.3.2. *Type B thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1800	13584.52	11.476	-2.58	1810	13699.14	11.450	-2.71	1820	13813.50	11.422	-2.83
1801	13595.99	11.473	-2.59	1811	13710.59	11.447	-2.72				
1802	13607.46	11.471	-2.61	1812	13722.04	11.444	-2.73				
1803	13618.93	11.468	-2.62	1813	13733.48	11.441	-2.74				
1804	13630.40	11.466	-2.63	1814	13744.92	11.439	-2.76				
1805	13641.86	11.463	-2.65	1815	13756.36	11.436	-2.77				
1806	13653.33	11.460	-2.66	1816	13767.79	11.433	-2.78				
1807	13664.78	11.458	-2.67	1817	13779.22	11.430	-2.79				
1808	13676.24	11.455	-2.68	1818	13790.65	11.428	-2.80				
1809	13687.69	11.452	-2.70	1819	13802.08	11.425	-2.81				
1810	13699.14	11.450	-2.71	1820	13813.50	11.422	-2.83				

TABLE 4.3.3. *Thermoelectric values at the fixed points for Type B thermocouples*

Fixed point	Temp. °C	E μV	S $\mu\text{V}/^\circ\text{C}$	dS/dT $\text{nV}/^\circ\text{C}^2$
Ice point	0.000	0.00	-0.247	11.82
Ether TP	26.870	-2.39	0.068	11.61
Water BP	100.000	33.18	0.900	11.16
Benzoic TP	122.370	56.09	1.148	11.06
Indium FP	156.634	101.88	1.524	10.90
Tin FP	231.9681	247.37	2.334	10.61
Bismuth FP	271.442	347.74	2.750	10.46
Cadmium FP	321.108	497.15	3.265	10.27
Lead FP	327.502	518.24	3.331	10.24
Mercury BP	356.660	619.69	3.627	10.12
Zinc FP	419.580	867.78	4.256	9.85
Sulphur BP	444.674	977.66	4.501	9.73
Cu-Al FP	548.23	1495.10	5.483	9.22
Antimony FP	630.74	1978.43	6.227	8.79
Aluminum FP	660.37	2166.77	6.485	8.64
Silver FP	961.93	4490.76	8.848	7.03
Gold FP	1064.43	5433.59	9.539	6.44
Copper FP	1084.5	5626.33	9.667	6.32
Nickel FP	1455	9576.58	11.441	2.78
Cobalt FP	1494	10024.76	11.539	2.23
Palladium FP	1554	10720.56	11.646	1.31
Platinum FP	1772	13262.22	11.543	-2.20

TABLE 4.3.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type B thermocouples*

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
0 to 200 °C	8	0.1	<0.01	<0.01	<0.01	<0.01
200 to 400 °C	8	0.3	0.02	<0.01	<0.01	<0.01
400 to 600 °C	8	0.8	0.03	<0.01	<0.01	<0.01
600 to 800 °C	8	2	0.05	<0.01	<0.01	<0.01
800 to 1000 °C	8	4	0.06	<0.01	<0.01	<0.01
1000 to 1200 °C	8	7	0.06	<0.01	<0.01	<0.01
1200 to 1400 °C	8	10	0.06	<0.01	<0.01	<0.01
1400 to 1600 °C	8	20	0.06	0.02	<0.01	<0.01
1600 to 1820 °C	8	40	0.09	0.03	<0.01	<0.01

4.4. Reference functions and Tables for the Positive Thermoelement, Type BP, a Platinum—30% Rhodium Alloy Versus Platinum, Pt-67

The coefficients for the eighth degree expansion for the thermoelectric voltage of Type BP thermoelements versus Pt-67 are given in table 4.4.1. The errors caused by using reduced bit arithmetic for calculating values of the functions are given in table 4.4.4.

The primary reference values for Type BP thermoelements versus Pt-67 are given in table 4.4.2. Values at selected fixed points are given in table 4.4.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 4.4.1, 4.4.2, and 4.4.3, respectively.

TABLE 4.4.1. Power series expansion for the thermoelectric voltage of Type BP thermoelements versus platinum, Pt-67

Temperature range	Degree	Coefficients	Term
0 to 1820 °C	8	4.8193620846	T
		$1.5702235198 \times 10^{-2}$	T^2
		$-2.2802418012 \times 10^{-6}$	T^3
		$3.1247260577 \times 10^{-8}$	T^4
		$-2.7550122645 \times 10^{-11}$	T^5
		$1.5024838175 \times 10^{-14}$	T^6
		$-4.6480201964 \times 10^{-18}$	T^7
		$6.1218136030 \times 10^{-22}$	T^8

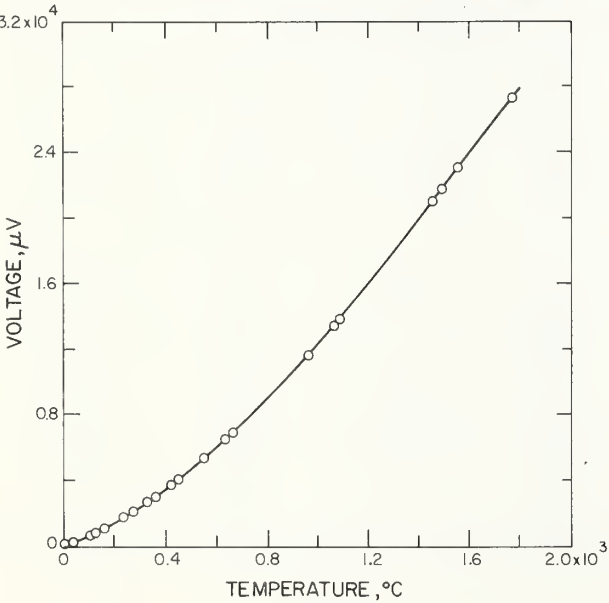


FIGURE 4.4.1. Thermoelectric voltage for Type BP thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

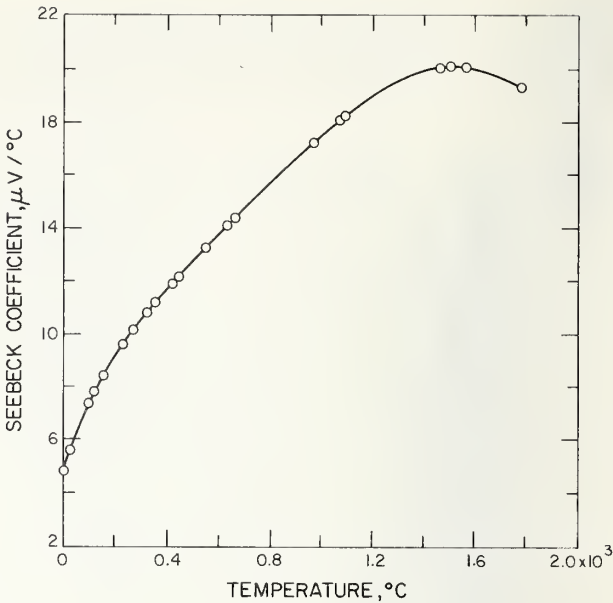


FIGURE 4.2.2. Seebeck coefficient for Type BP thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

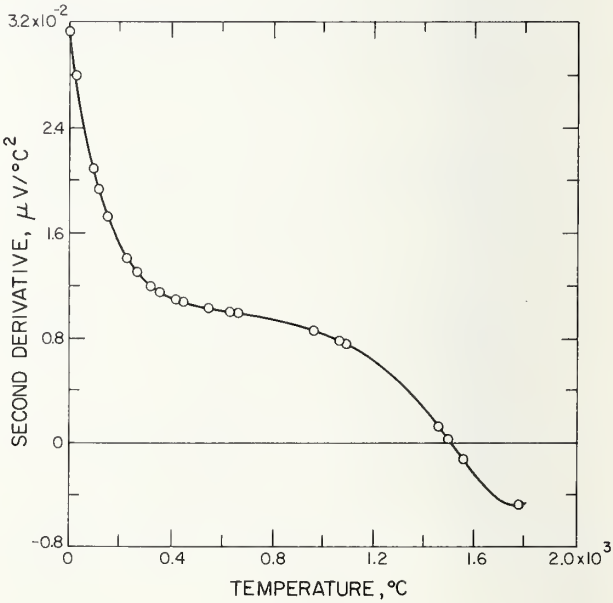


FIGURE 4.4.3. Second derivative of thermoelectric voltage for Type BP thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 4.4.2. Type BP thermoelements versus platinum, Pt-67—Thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0°C

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.00	4.819	31.40	60	341.15	6.483	24.43	120	770.87	7.792	19.52
1	4.84	4.851	31.27	61	347.64	6.507	24.34	121	778.67	7.812	19.46
2	9.70	4.882	31.13	62	354.16	6.531	24.24	122	786.49	7.831	19.39
3	14.60	4.913	31.00	63	360.71	6.556	24.14	123	794.33	7.851	19.32
4	19.53	4.944	30.86	64	367.27	6.580	24.05	124	802.20	7.870	19.26
5	24.49	4.975	30.73	65	373.87	6.604	23.95	125	810.07	7.889	19.19
6	29.48	5.005	30.60	66	380.48	6.628	23.86	126	817.97	7.908	19.12
7	34.50	5.036	30.46	67	387.12	6.651	23.76	127	825.89	7.927	19.06
8	39.55	5.066	30.33	68	393.78	6.675	23.67	128	833.83	7.946	18.99
9	44.63	5.097	30.20	69	400.47	6.699	23.58	129	841.78	7.965	18.93
10	49.74	5.127	30.07	70	407.18	6.722	23.49	130	849.76	7.984	18.87
11	54.88	5.157	29.94	71	413.91	6.746	23.39	131	857.75	8.003	18.80
12	60.05	5.187	29.82	72	420.67	6.769	23.30	132	865.77	8.022	18.74
13	65.26	5.216	29.69	73	427.45	6.792	23.21	133	873.80	8.041	18.68
14	70.49	5.246	29.56	74	434.26	6.815	23.12	134	881.85	8.059	18.62
15	75.75	5.275	29.43	75	441.08	6.838	23.03	135	889.92	8.078	18.55
16	81.04	5.305	29.31	76	447.93	6.861	22.95	136	898.00	8.096	18.49
17	86.36	5.334	29.18	77	454.81	6.884	22.86	137	906.11	8.115	18.43
18	91.71	5.363	29.06	78	461.70	6.907	22.77	138	914.23	8.133	18.37
19	97.08	5.392	28.94	79	468.62	6.930	22.68	139	922.37	8.152	18.31
20	102.49	5.421	28.81	80	475.56	6.953	22.59	140	930.54	8.170	18.25
21	107.93	5.450	28.69	81	482.53	6.975	22.51	141	938.71	8.188	18.19
22	113.39	5.478	28.57	82	489.51	6.998	22.42	142	946.91	8.206	18.13
23	118.88	5.507	28.45	83	496.52	7.020	22.34	143	955.13	8.224	18.07
24	124.40	5.535	28.33	84	503.55	7.042	22.25	144	963.36	8.242	18.02
25	129.95	5.564	28.21	85	510.61	7.064	22.17	145	971.61	8.260	17.96
26	135.53	5.592	28.09	86	517.68	7.087	22.08	146	979.88	8.278	17.90
27	141.14	5.620	27.97	87	524.78	7.109	22.00	147	988.17	8.296	17.84
28	146.77	5.648	27.86	88	531.90	7.131	21.92	148	996.47	8.314	17.79
29	152.43	5.676	27.74	89	539.04	7.152	21.84	149	1004.80	8.332	17.73
30	158.12	5.703	27.62	90	546.20	7.174	21.76	150	1013.14	8.349	17.67
31	163.84	5.731	27.51	91	553.39	7.196	21.67	151	1021.49	8.367	17.62
32	169.58	5.758	27.39	92	560.59	7.218	21.59	152	1029.87	8.385	17.56
33	175.36	5.786	27.28	93	567.82	7.239	21.51	153	1038.26	8.402	17.51
34	181.15	5.813	27.17	94	575.07	7.261	21.43	154	1046.68	8.420	17.45
35	186.98	5.840	27.05	95	582.34	7.282	21.35	155	1055.10	8.437	17.40
36	192.83	5.867	26.94	96	589.64	7.303	21.28	156	1063.55	8.455	17.34
37	198.71	5.894	26.83	97	596.95	7.325	21.20	157	1072.01	8.472	17.29
38	204.62	5.921	26.72	98	604.29	7.346	21.12	158	1080.49	8.489	17.24
39	210.56	5.947	26.61	99	611.64	7.367	21.04	159	1088.99	8.506	17.18
40	216.52	5.974	26.50	100	619.02	7.388	20.96	160	1097.51	8.523	17.13
41	222.50	6.000	26.39	101	626.42	7.409	20.89	161	1106.04	8.541	17.08
42	228.52	6.027	26.28	102	633.84	7.430	20.81	162	1114.59	8.558	17.03
43	234.56	6.053	26.17	103	641.28	7.450	20.74	163	1123.15	8.575	16.98
44	240.62	6.079	26.07	104	648.74	7.471	20.66	164	1131.74	8.592	16.93
45	246.71	6.105	25.96	105	656.22	7.492	20.59	165	1140.34	8.608	16.87
46	252.83	6.131	25.85	106	663.72	7.512	20.51	166	1148.95	8.625	16.82
47	258.98	6.157	25.75	107	671.24	7.533	20.44	167	1157.59	8.642	16.77
48	265.14	6.182	25.64	108	678.79	7.553	20.37	168	1166.24	8.659	16.72
49	271.34	6.208	25.54	109	686.35	7.573	20.29	169	1174.90	8.676	16.67
50	277.56	6.233	25.44	110	693.93	7.594	20.22	170	1183.59	8.692	16.63
51	283.81	6.259	25.33	111	701.54	7.614	20.15	171	1192.29	8.709	16.58
52	290.08	6.284	25.23	112	709.16	7.634	20.08	172	1201.01	8.725	16.53
53	296.37	6.309	25.13	113	716.81	7.654	20.01	173	1209.74	8.742	16.48
54	302.70	6.334	25.03	114	724.47	7.674	19.94	174	1218.49	8.758	16.43
55	309.04	6.359	24.93	115	732.15	7.694	19.87	175	1227.26	8.775	16.38
56	315.41	6.384	24.83	116	739.86	7.714	19.80	176	1236.04	8.791	16.34
57	321.81	6.409	24.73	117	747.58	7.734	19.73	177	1244.84	8.807	16.29
58	328.23	6.434	24.63	118	755.32	7.753	19.66	178	1253.65	8.824	16.24
59	334.68	6.458	24.53	119	763.09	7.773	19.59	179	1262.49	8.840	16.20
60	341.15	6.483	24.43	120	770.87	7.792	19.52	180	1271.33	8.856	16.15

TABLE 4.4.2. *Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	1271.33	8.856	16.15	240	1830.27	9.753	13.90	300	2439.48	10.539	12.43
181	1280.20	8.872	16.11	241	1840.03	9.767	13.87	301	2450.02	10.552	12.41
182	1289.08	8.888	16.06	242	1849.81	9.781	13.84	302	2460.58	10.564	12.39
183	1297.97	8.904	16.01	243	1859.59	9.794	13.81	303	2471.15	10.577	12.37
184	1306.89	8.920	15.97	244	1869.40	9.808	13.78	304	2481.73	10.589	12.36
185	1315.81	8.936	15.93	245	1879.21	9.822	13.75	305	2492.33	10.601	12.34
186	1324.76	8.952	15.88	246	1889.04	9.836	13.72	306	2502.94	10.614	12.32
187	1333.72	8.968	15.84	247	1898.88	9.849	13.69	307	2513.56	10.626	12.30
188	1342.69	8.984	15.79	248	1908.74	9.863	13.66	308	2524.19	10.638	12.28
189	1351.69	9.000	15.75	249	1918.61	9.877	13.63	309	2534.83	10.651	12.26
190	1360.69	9.015	15.71	250	1928.49	9.890	13.61	310	2545.49	10.663	12.25
191	1369.72	9.031	15.66	251	1938.39	9.904	13.58	311	2556.16	10.675	12.23
192	1378.76	9.047	15.62	252	1948.30	9.917	13.55	312	2566.84	10.687	12.21
193	1387.81	9.062	15.58	253	1958.22	9.931	13.52	313	2577.53	10.699	12.19
194	1396.88	9.078	15.54	254	1968.16	9.944	13.49	314	2588.24	10.712	12.18
195	1405.97	9.093	15.50	255	1978.11	9.958	13.47	315	2598.96	10.724	12.16
196	1415.07	9.109	15.46	256	1988.08	9.971	13.44	316	2609.69	10.736	12.14
197	1424.18	9.124	15.41	257	1998.06	9.985	13.41	317	2620.43	10.748	12.12
198	1433.32	9.140	15.37	258	2008.05	9.998	13.39	318	2631.18	10.760	12.11
199	1442.46	9.155	15.33	259	2018.05	10.012	13.36	319	2641.95	10.772	12.09
200	1451.63	9.170	15.29	260	2028.07	10.025	13.33	320	2652.73	10.784	12.07
201	1460.80	9.186	15.25	261	2038.10	10.038	13.31	321	2663.52	10.796	12.06
202	1470.00	9.201	15.21	262	2048.15	10.052	13.28	322	2674.32	10.808	12.04
203	1479.21	9.216	15.17	263	2058.20	10.065	13.26	323	2685.13	10.820	12.02
204	1488.43	9.231	15.14	264	2068.28	10.078	13.23	324	2695.96	10.833	12.01
205	1497.67	9.246	15.10	265	2078.36	10.091	13.21	325	2706.80	10.845	11.99
206	1506.92	9.261	15.06	266	2088.46	10.105	13.18	326	2717.65	10.856	11.98
207	1516.19	9.276	15.02	267	2098.57	10.118	13.16	327	2728.51	10.868	11.96
208	1525.47	9.291	14.98	268	2108.69	10.131	13.13	328	2739.39	10.880	11.94
209	1534.77	9.306	14.94	269	2118.83	10.144	13.11	329	2750.27	10.892	11.93
210	1544.09	9.321	14.91	270	2128.98	10.157	13.08	330	2761.17	10.904	11.91
211	1553.42	9.336	14.87	271	2139.15	10.170	13.06	331	2772.08	10.916	11.90
212	1562.76	9.351	14.83	272	2149.32	10.183	13.03	332	2783.00	10.928	11.88
213	1572.12	9.366	14.80	273	2159.51	10.196	13.01	333	2793.94	10.940	11.87
214	1581.49	9.381	14.76	274	2169.71	10.209	12.99	334	2804.88	10.952	11.85
215	1590.88	9.395	14.72	275	2179.93	10.222	12.96	335	2815.84	10.964	11.84
216	1600.28	9.410	14.69	276	2190.16	10.235	12.94	336	2826.81	10.975	11.82
217	1609.70	9.425	14.65	277	2200.40	10.248	12.92	337	2837.79	10.987	11.81
218	1619.13	9.439	14.62	278	2210.65	10.261	12.89	338	2848.79	10.999	11.80
219	1628.58	9.454	14.58	279	2220.92	10.274	12.87	339	2859.79	11.011	11.78
220	1638.04	9.469	14.55	280	2231.20	10.287	12.85	340	2870.81	11.023	11.77
221	1647.51	9.483	14.51	281	2241.50	10.300	12.83	341	2881.84	11.034	11.75
222	1657.00	9.498	14.48	282	2251.80	10.312	12.80	342	2892.88	11.046	11.74
223	1666.51	9.512	14.44	283	2262.12	10.325	12.78	343	2903.93	11.058	11.72
224	1676.03	9.526	14.41	284	2272.45	10.338	12.76	344	2914.99	11.070	11.71
225	1685.56	9.541	14.37	285	2282.80	10.351	12.74	345	2926.07	11.081	11.70
226	1695.11	9.555	14.34	286	2293.15	10.363	12.72	346	2937.15	11.093	11.68
227	1704.67	9.570	14.31	287	2303.52	10.376	12.70	347	2948.25	11.105	11.67
228	1714.25	9.584	14.27	288	2313.91	10.389	12.67	348	2959.36	11.116	11.66
229	1723.84	9.598	14.24	289	2324.30	10.401	12.65	349	2970.49	11.128	11.64
230	1733.45	9.612	14.21	290	2334.71	10.414	12.63	350	2981.62	11.140	11.63
231	1743.07	9.626	14.18	291	2345.13	10.427	12.61	351	2992.77	11.151	11.62
232	1752.70	9.641	14.15	292	2355.56	10.439	12.59	352	3003.92	11.163	11.60
233	1762.35	9.655	14.11	293	2366.01	10.452	12.57	353	3015.09	11.174	11.59
234	1772.01	9.669	14.08	294	2376.47	10.464	12.55	354	3026.27	11.186	11.58
235	1781.68	9.683	14.05	295	2386.94	10.477	12.53	355	3037.46	11.198	11.57
236	1791.37	9.697	14.02	296	2397.42	10.490	12.51	356	3048.67	11.209	11.55
237	1801.08	9.711	13.99	297	2407.92	10.502	12.49	357	3059.88	11.221	11.54
238	1810.80	9.725	13.96	298	2418.42	10.514	12.47	358	3071.11	11.232	11.53
239	1820.53	9.739	13.93	299	2428.94	10.527	12.45	359	3082.35	11.244	11.52
240	1830.27	9.753	13.90	300	2439.48	10.539	12.43	360	3093.60	11.255	11.50

TABLE 4.4.2. *Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	3093.60	11.255	11.50	420	3789.23	11.927	10.93	480	4524.27	12.571	10.56
361	3104.86	11.267	11.49	421	3801.17	11.938	10.92	481	4536.85	12.581	10.56
362	3116.13	11.278	11.48	422	3813.11	11.949	10.91	482	4549.43	12.592	10.55
363	3127.41	11.290	11.47	423	3825.06	11.960	10.90	483	4562.03	12.602	10.55
364	3138.71	11.301	11.46	424	3837.03	11.971	10.90	484	4574.64	12.613	10.54
365	3150.02	11.313	11.45	425	3849.00	11.981	10.89	485	4587.26	12.623	10.54
366	3161.33	11.324	11.43	426	3860.99	11.992	10.88	486	4599.89	12.634	10.53
367	3172.66	11.336	11.42	427	3872.99	12.003	10.88	487	4612.52	12.645	10.53
368	3184.01	11.347	11.41	428	3885.00	12.014	10.87	488	4625.17	12.655	10.52
369	3195.36	11.358	11.40	429	3897.02	12.025	10.86	489	4637.83	12.666	10.52
370	3206.72	11.370	11.39	430	3909.05	12.036	10.85	490	4650.51	12.676	10.51
371	3218.10	11.381	11.38	431	3921.09	12.047	10.85	491	4663.19	12.687	10.51
372	3229.48	11.393	11.37	432	3933.14	12.057	10.84	492	4675.88	12.697	10.51
373	3240.88	11.404	11.35	433	3945.20	12.068	10.83	493	4688.58	12.708	10.50
374	3252.29	11.415	11.34	434	3957.28	12.079	10.83	494	4701.29	12.718	10.50
375	3263.71	11.427	11.33	435	3969.36	12.090	10.82	495	4714.02	12.729	10.49
376	3275.14	11.438	11.32	436	3981.46	12.101	10.81	496	4726.75	12.739	10.49
377	3286.59	11.449	11.31	437	3993.56	12.112	10.81	497	4739.50	12.750	10.48
378	3298.04	11.461	11.30	438	4005.68	12.122	10.80	498	4752.25	12.760	10.48
379	3309.51	11.472	11.29	439	4017.81	12.133	10.79	499	4765.02	12.771	10.47
380	3320.99	11.483	11.28	440	4029.95	12.144	10.79	500	4777.79	12.781	10.47
381	3332.48	11.494	11.27	441	4042.10	12.155	10.78	501	4790.58	12.792	10.47
382	3343.98	11.506	11.26	442	4054.26	12.166	10.77	502	4803.37	12.802	10.46
383	3355.49	11.517	11.25	443	4066.43	12.176	10.77	503	4816.18	12.812	10.46
384	3367.01	11.528	11.24	444	4078.61	12.187	10.76	504	4829.00	12.823	10.45
385	3378.54	11.539	11.23	445	4090.80	12.198	10.76	505	4841.83	12.833	10.45
386	3390.09	11.551	11.22	446	4103.00	12.209	10.75	506	4854.67	12.844	10.45
387	3401.64	11.562	11.21	447	4115.22	12.219	10.74	507	4867.52	12.854	10.44
388	3413.21	11.573	11.20	448	4127.44	12.230	10.74	508	4880.37	12.865	10.44
389	3424.79	11.584	11.19	449	4139.68	12.241	10.73	509	4893.24	12.875	10.43
390	3436.38	11.595	11.18	450	4151.92	12.252	10.72	510	4906.13	12.886	10.43
391	3447.98	11.607	11.17	451	4164.18	12.262	10.72	511	4919.02	12.896	10.42
392	3459.59	11.618	11.16	452	4176.45	12.273	10.71	512	4931.92	12.906	10.42
393	3471.22	11.629	11.15	453	4188.73	12.284	10.71	513	4944.83	12.917	10.42
394	3482.85	11.640	11.14	454	4201.02	12.294	10.70	514	4957.75	12.927	10.41
395	3494.50	11.651	11.13	455	4213.32	12.305	10.69	515	4970.68	12.938	10.41
396	3506.15	11.662	11.13	456	4225.63	12.316	10.69	516	4983.63	12.948	10.40
397	3517.82	11.673	11.12	457	4237.95	12.326	10.68	517	4996.58	12.958	10.40
398	3529.50	11.685	11.11	458	4250.28	12.337	10.68	518	5009.54	12.969	10.40
399	3541.19	11.696	11.10	459	4262.62	12.348	10.67	519	5022.52	12.979	10.39
400	3552.89	11.707	11.09	460	4274.98	12.358	10.67	520	5035.50	12.990	10.39
401	3564.60	11.718	11.08	461	4287.34	12.369	10.66	521	5048.50	13.000	10.39
402	3576.33	11.729	11.07	462	4299.71	12.380	10.66	522	5061.50	13.010	10.38
403	3588.06	11.740	11.06	463	4312.10	12.390	10.65	523	5074.52	13.021	10.38
404	3599.81	11.751	11.06	464	4324.49	12.401	10.64	524	5087.54	13.031	10.37
405	3611.56	11.762	11.05	465	4336.90	12.412	10.64	525	5100.58	13.042	10.37
406	3623.33	11.773	11.04	466	4349.32	12.422	10.63	526	5113.63	13.052	10.37
407	3635.11	11.784	11.03	467	4361.75	12.433	10.63	527	5126.68	13.062	10.36
408	3646.90	11.795	11.02	468	4374.18	12.444	10.62	528	5139.75	13.073	10.36
409	3658.70	11.806	11.01	469	4386.63	12.454	10.62	529	5152.83	13.083	10.36
410	3670.51	11.817	11.00	470	4399.09	12.465	10.61	530	5165.92	13.093	10.35
411	3682.34	11.828	11.00	471	4411.56	12.475	10.61	531	5179.01	13.104	10.35
412	3694.17	11.839	10.99	472	4424.04	12.486	10.60	532	5192.12	13.114	10.34
413	3706.01	11.850	10.98	473	4436.53	12.497	10.60	533	5205.24	13.124	10.34
414	3717.87	11.861	10.97	474	4449.04	12.507	10.59	534	5218.37	13.135	10.34
415	3729.74	11.872	10.97	475	4461.55	12.518	10.59	535	5231.51	13.145	10.33
416	3741.61	11.883	10.96	476	4474.07	12.528	10.58	536	5244.66	13.155	10.33
417	3753.50	11.894	10.95	477	4486.61	12.539	10.58	537	5257.82	13.166	10.33
418	3765.40	11.905	10.94	478	4499.15	12.550	10.57	538	5270.99	13.176	10.32
419	3777.31	11.916	10.93	479	4511.71	12.560	10.57	539	5284.17	13.186	10.32
420	3789.23	11.927	10.93	480	4524.27	12.571	10.56	540	5297.37	13.197	10.32

TABLE 4.4.2. *Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	5297.37	13.197	10.32	600	6107.61	13.810	10.12	660	6954.31	14.412	9.95
541	5310.57	13.207	10.31	601	6121.43	13.820	10.12	661	6968.73	14.422	9.94
542	5323.78	13.217	10.31	602	6135.25	13.830	10.12	662	6983.15	14.432	9.94
543	5337.00	13.228	10.30	603	6149.09	13.840	10.11	663	6997.59	14.442	9.94
544	5350.24	13.238	10.30	604	6162.93	13.850	10.11	664	7012.03	14.451	9.93
545	5363.48	13.248	10.30	605	6176.79	13.860	10.11	665	7026.49	14.461	9.93
546	5376.73	13.258	10.29	606	6190.65	13.870	10.11	666	7040.96	14.471	9.93
547	5390.00	13.269	10.29	607	6204.53	13.880	10.10	667	7055.43	14.481	9.92
548	5403.27	13.279	10.29	608	6218.41	13.891	10.10	668	7069.92	14.491	9.92
549	5416.55	13.289	10.28	609	6232.31	13.901	10.10	669	7084.42	14.501	9.92
550	5429.85	13.300	10.28	610	6246.22	13.911	10.09	670	7098.92	14.511	9.91
551	5443.15	13.310	10.28	611	6260.13	13.921	10.09	671	7113.44	14.521	9.91
552	5456.47	13.320	10.27	612	6274.06	13.931	10.09	672	7127.96	14.531	9.91
553	5469.79	13.330	10.27	613	6287.99	13.941	10.08	673	7142.50	14.541	9.91
554	5483.13	13.341	10.27	614	6301.94	13.951	10.08	674	7157.05	14.551	9.90
555	5496.47	13.351	10.26	615	6315.90	13.961	10.08	675	7171.60	14.561	9.90
556	5509.83	13.361	10.26	616	6329.86	13.971	10.08	676	7186.17	14.570	9.90
557	5523.20	13.372	10.26	617	6343.84	13.981	10.07	677	7200.74	14.580	9.89
558	5536.57	13.382	10.25	618	6357.82	13.991	10.07	678	7215.33	14.590	9.89
559	5549.96	13.392	10.25	619	6371.82	14.001	10.07	679	7229.92	14.600	9.89
560	5563.36	13.402	10.25	620	6385.83	14.012	10.06	680	7244.53	14.610	9.88
561	5576.77	13.413	10.24	621	6399.84	14.022	10.06	681	7259.14	14.620	9.88
562	5590.08	13.423	10.24	622	6413.87	14.032	10.06	682	7273.77	14.630	9.88
563	5603.61	13.433	10.24	623	6427.91	14.042	10.06	683	7288.40	14.640	9.87
564	5617.05	13.443	10.23	624	6441.95	14.052	10.05	684	7303.05	14.650	9.87
565	5630.50	13.453	10.23	625	6456.01	14.062	10.05	685	7317.70	14.659	9.87
566	5643.96	13.464	10.23	626	6470.08	14.072	10.05	686	7332.37	14.669	9.87
567	5657.42	13.474	10.23	627	6484.15	14.082	10.04	687	7347.04	14.679	9.86
568	5670.90	13.484	10.22	628	6498.24	14.092	10.04	688	7361.72	14.689	9.86
569	5684.39	13.494	10.22	629	6512.34	14.102	10.04	689	7376.42	14.699	9.86
570	5697.89	13.505	10.22	630	6526.45	14.112	10.03	690	7391.12	14.709	9.85
571	5711.40	13.515	10.21	631	6540.56	14.122	10.03	691	7405.84	14.719	9.85
572	5724.92	13.525	10.21	632	6554.69	14.132	10.03	692	7420.56	14.728	9.85
573	5738.45	13.535	10.21	633	6568.83	14.142	10.03	693	7435.29	14.738	9.84
574	5751.99	13.545	10.20	634	6582.97	14.152	10.02	694	7450.04	14.748	9.84
575	5765.54	13.556	10.20	635	6597.13	14.162	10.02	695	7464.79	14.758	9.84
576	5779.10	13.566	10.20	636	6611.30	14.172	10.02	696	7479.55	14.768	9.83
577	5792.67	13.576	10.19	637	6625.48	14.182	10.01	697	7494.32	14.778	9.83
578	5806.26	13.586	10.19	638	6639.66	14.192	10.01	698	7509.11	14.787	9.83
579	5819.85	13.596	10.19	639	6653.86	14.202	10.01	699	7523.90	14.797	9.82
580	5833.45	13.607	10.18	640	6668.07	14.212	10.00	700	7538.70	14.807	9.82
581	5847.06	13.617	10.18	641	6682.28	14.222	10.00	701	7553.51	14.817	9.82
582	5860.68	13.627	10.18	642	6696.51	14.232	10.00	702	7568.34	14.827	9.82
583	5874.31	13.637	10.17	643	6710.75	14.242	10.00	703	7583.17	14.837	9.81
584	5887.96	13.647	10.17	644	6725.00	14.252	9.99	704	7598.01	14.846	9.81
585	5901.61	13.657	10.17	645	6739.25	14.262	9.99	705	7612.86	14.856	9.81
586	5915.27	13.668	10.17	646	6753.52	14.272	9.99	706	7627.72	14.866	9.80
587	5928.94	13.678	10.16	647	6767.80	14.282	9.98	707	7642.59	14.876	9.80
588	5942.63	13.688	10.16	648	6782.08	14.292	9.98	708	7657.47	14.886	9.80
589	5956.32	13.698	10.16	649	6796.38	14.302	9.98	709	7672.36	14.895	9.79
590	5970.02	13.708	10.15	650	6810.69	14.312	9.98	710	7687.26	14.905	9.79
591	5983.74	13.718	10.15	651	6825.01	14.322	9.97	711	7702.17	14.915	9.79
592	5997.46	13.729	10.15	652	6839.33	14.332	9.97	712	7717.09	14.925	9.78
593	6011.19	13.739	10.14	653	6853.67	14.342	9.97	713	7732.02	14.934	9.78
594	6024.94	13.749	10.14	654	6868.02	14.352	9.96	714	7746.96	14.944	9.78
595	6038.69	13.759	10.14	655	6882.37	14.362	9.96	715	7761.91	14.954	9.77
596	6052.46	13.769	10.14	656	6896.74	14.372	9.96	716	7776.87	14.964	9.77
597	6066.23	13.779	10.13	657	6911.12	14.382	9.95	717	7791.84	14.974	9.77
598	6080.01	13.789	10.13	658	6925.50	14.392	9.95	718	7806.82	14.983	9.76
599	6093.81	13.800	10.13	659	6939.90	14.402	9.95	719	7821.80	14.993	9.76
600	6107.61	13.810	10.12	660	6954.31	14.412	9.95	720	7836.80	15.003	9.76

TABLE 4.4.2. *Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	7836.80	15.003	9.76	780	8754.41	15.582	9.54	840	9706.36	16.147	9.29
721	7851.81	15.013	9.75	781	8770.00	15.591	9.54	841	9722.51	16.156	9.29
722	7866.83	15.022	9.75	782	8785.59	15.601	9.53	842	9738.67	16.166	9.28
723	7881.86	15.032	9.75	783	8801.20	15.611	9.53	843	9754.84	16.175	9.28
724	7896.89	15.042	9.74	784	8816.82	15.620	9.53	844	9771.02	16.184	9.27
725	7911.94	15.052	9.74	785	8832.44	15.630	9.52	845	9787.21	16.193	9.27
726	7927.00	15.061	9.74	786	8848.07	15.639	9.52	846	9803.41	16.203	9.26
727	7942.06	15.071	9.73	787	8863.72	15.649	9.51	847	9819.61	16.212	9.26
728	7957.14	15.081	9.73	788	8879.37	15.658	9.51	848	9835.83	16.221	9.25
729	7972.22	15.091	9.73	789	8895.04	15.668	9.51	849	9852.06	16.231	9.25
730	7987.32	15.100	9.72	790	8910.71	15.677	9.50	850	9868.29	16.240	9.24
731	8002.42	15.110	9.72	791	8926.39	15.687	9.50	851	9884.54	16.249	9.24
732	8017.54	15.120	9.72	792	8942.08	15.696	9.49	852	9900.79	16.258	9.23
733	8032.66	15.129	9.71	793	8957.78	15.706	9.49	853	9917.05	16.267	9.23
734	8047.80	15.139	9.71	794	8973.49	15.715	9.49	854	9933.33	16.277	9.23
735	8062.94	15.149	9.71	795	8989.21	15.725	9.48	855	9949.61	16.286	9.22
736	8078.10	15.159	9.70	796	9004.94	15.734	9.48	856	9965.90	16.295	9.22
737	8093.26	15.168	9.70	797	9020.68	15.744	9.47	857	9982.20	16.304	9.21
738	8108.43	15.178	9.69	798	9036.43	15.753	9.47	858	9998.51	16.314	9.21
739	8123.61	15.188	9.69	799	9052.19	15.763	9.47	859	10014.82	16.323	9.20
740	8138.81	15.197	9.69	800	9067.95	15.772	9.46	860	10031.15	16.332	9.20
741	8154.01	15.207	9.68	801	9083.73	15.781	9.46	861	10047.49	16.341	9.19
742	8169.22	15.217	9.68	802	9099.52	15.791	9.45	862	10063.83	16.350	9.19
743	8184.44	15.226	9.68	803	9115.31	15.800	9.45	863	10080.19	16.360	9.18
744	8199.67	15.236	9.67	804	9131.12	15.810	9.45	864	10096.55	16.369	9.18
745	8214.91	15.246	9.67	805	9146.93	15.819	9.44	865	10112.93	16.378	9.17
746	8230.17	15.255	9.67	806	9162.76	15.829	9.44	866	10129.31	16.387	9.17
747	8245.43	15.265	9.66	807	9178.59	15.838	9.43	867	10145.70	16.396	9.16
748	8260.70	15.275	9.66	808	9194.43	15.848	9.43	868	10162.10	16.405	9.16
749	8275.97	15.284	9.66	809	9210.28	15.857	9.42	869	10178.51	16.415	9.15
750	8291.26	15.294	9.65	810	9226.15	15.866	9.42	870	10194.93	16.424	9.15
751	8306.56	15.304	9.65	811	9242.02	15.876	9.42	871	10211.36	16.433	9.14
752	8321.87	15.313	9.65	812	9257.90	15.885	9.41	872	10227.80	16.442	9.14
753	8337.19	15.323	9.64	813	9273.79	15.895	9.41	873	10244.24	16.451	9.13
754	8352.52	15.333	9.64	814	9289.69	15.904	9.40	874	10260.70	16.460	9.13
755	8367.85	15.342	9.63	815	9305.60	15.913	9.40	875	10277.16	16.469	9.12
756	8383.20	15.352	9.63	816	9321.51	15.923	9.40	876	10293.64	16.478	9.12
757	8398.56	15.361	9.63	817	9337.44	15.932	9.39	877	10310.12	16.488	9.11
758	8413.92	15.371	9.62	818	9353.38	15.942	9.39	878	10326.61	16.497	9.11
759	8429.30	15.381	9.62	819	9369.32	15.951	9.38	879	10343.11	16.506	9.10
760	8444.69	15.390	9.62	820	9385.28	15.960	9.38	880	10359.62	16.515	9.10
761	8460.08	15.400	9.61	821	9401.25	15.970	9.37	881	10376.14	16.524	9.09
762	8475.49	15.410	9.61	822	9417.22	15.979	9.37	882	10392.67	16.533	9.09
763	8490.90	15.419	9.61	823	9433.20	15.989	9.37	883	10409.21	16.542	9.08
764	8506.32	15.429	9.60	824	9449.20	15.998	9.36	884	10425.76	16.551	9.08
765	8521.76	15.438	9.60	825	9465.20	16.007	9.36	885	10442.31	16.560	9.07
766	8537.20	15.448	9.59	826	9481.21	16.017	9.35	886	10458.88	16.569	9.07
767	8552.65	15.458	9.59	827	9497.23	16.026	9.35	887	10475.45	16.578	9.06
768	8568.12	15.467	9.59	828	9513.26	16.035	9.34	888	10492.03	16.588	9.06
769	8583.59	15.477	9.58	829	9529.30	16.045	9.34	889	10508.63	16.597	9.05
770	8599.07	15.486	9.58	830	9545.35	16.054	9.33	890	10525.23	16.606	9.05
771	8614.56	15.496	9.58	831	9561.41	16.063	9.33	891	10541.84	16.615	9.04
772	8630.06	15.505	9.57	832	9577.48	16.073	9.33	892	10558.46	16.624	9.04
773	8645.57	15.515	9.57	833	9593.56	16.082	9.32	893	10575.08	16.633	9.03
774	8661.09	15.525	9.56	834	9609.64	16.091	9.32	894	10591.72	16.642	9.03
775	8676.62	15.534	9.56	835	9625.74	16.101	9.31	895	10608.37	16.651	9.02
776	8692.16	15.544	9.56	836	9641.84	16.110	9.31	896	10625.02	16.660	9.01
777	8707.71	15.553	9.55	837	9657.96	16.119	9.30	897	10641.69	16.669	9.01
778	8723.27	15.563	9.55	838	9674.08	16.128	9.30	898	10658.36	16.678	9.00
779	8738.83	15.572	9.55	839	9690.22	16.138	9.29	899	10675.04	16.687	9.00
780	8754.41	15.582	9.54	840	9706.36	16.147	9.29	900	10691.73	16.696	8.99

TABLE 4.4.2. Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	10691.73	16.696	8.99	960	11709.47	17.225	8.64	1020	12758.29	17.731	8.21
901	10708.44	16.705	8.99	961	11726.70	17.234	8.63	1021	12776.02	17.739	8.21
902	10725.14	16.714	8.98	962	11743.94	17.242	8.63	1022	12793.77	17.748	8.20
903	10741.86	16.723	8.98	963	11761.18	17.251	8.62	1023	12811.52	17.756	8.19
904	10758.59	16.732	8.97	964	11778.44	17.260	8.61	1024	12829.28	17.764	8.18
905	10775.33	16.741	8.97	965	11795.70	17.268	8.61	1025	12847.04	17.772	8.18
906	10792.07	16.750	8.96	966	11812.98	17.277	8.60	1026	12864.82	17.780	8.17
907	10808.83	16.759	8.96	967	11830.26	17.285	8.59	1027	12882.61	17.788	8.16
908	10825.59	16.768	8.95	968	11847.55	17.294	8.59	1028	12900.40	17.797	8.15
909	10842.36	16.777	8.94	969	11864.85	17.303	8.58	1029	12918.20	17.805	8.14
910	10859.14	16.786	8.94	970	11882.15	17.311	8.57	1030	12936.01	17.813	8.14
911	10875.93	16.794	8.93	971	11899.47	17.320	8.57	1031	12953.82	17.821	8.13
912	10892.73	16.803	8.93	972	11916.79	17.328	8.56	1032	12971.65	17.829	8.12
913	10909.54	16.812	8.92	973	11934.12	17.337	8.55	1033	12989.48	17.837	8.11
914	10926.36	16.821	8.92	974	11951.47	17.345	8.55	1034	13007.32	17.845	8.10
915	10943.18	16.830	8.91	975	11968.82	17.354	8.54	1035	13025.17	17.853	8.09
916	10960.02	16.839	8.91	976	11986.17	17.363	8.53	1036	13043.03	17.862	8.09
917	10976.86	16.848	8.90	977	12003.54	17.371	8.53	1037	13060.90	17.870	8.08
918	10993.71	16.857	8.89	978	12020.92	17.380	8.52	1038	13078.77	17.878	8.07
919	11010.57	16.866	8.89	979	12038.30	17.388	8.51	1039	13096.65	17.886	8.06
920	11027.44	16.875	8.88	980	12055.69	17.397	8.51	1040	13114.54	17.894	8.05
921	11044.32	16.883	8.88	981	12073.09	17.405	8.50	1041	13132.44	17.902	8.05
922	11061.21	16.892	8.87	982	12090.50	17.414	8.49	1042	13150.35	17.910	8.04
923	11078.11	16.901	8.87	983	12107.92	17.422	8.49	1043	13168.26	17.918	8.03
924	11095.01	16.910	8.86	984	12125.35	17.431	8.48	1044	13186.18	17.926	8.02
925	11111.93	16.919	8.85	985	12142.78	17.439	8.47	1045	13204.11	17.934	8.01
926	11128.85	16.928	8.85	986	12160.22	17.448	8.47	1046	13222.05	17.942	8.00
927	11145.78	16.937	8.84	987	12177.68	17.456	8.46	1047	13240.00	17.950	8.00
928	11162.72	16.945	8.84	988	12195.14	17.464	8.45	1048	13257.95	17.958	7.99
929	11179.67	16.954	8.83	989	12212.61	17.473	8.44	1049	13275.91	17.966	7.98
930	11196.63	16.963	8.82	990	12230.08	17.481	8.44	1050	13293.88	17.974	7.97
931	11213.60	16.972	8.82	991	12247.57	17.490	8.43	1051	13311.86	17.982	7.96
932	11230.58	16.981	8.81	992	12265.06	17.498	8.42	1052	13329.85	17.990	7.95
933	11247.56	16.990	8.81	993	12282.56	17.507	8.42	1053	13347.84	17.998	7.94
934	11264.56	16.998	8.80	994	12300.08	17.515	8.41	1054	13365.84	18.006	7.94
935	11281.56	17.007	8.79	995	12317.59	17.523	8.40	1055	13383.85	18.014	7.93
936	11298.57	17.016	8.79	996	12335.12	17.532	8.39	1056	13401.87	18.022	7.92
937	11315.59	17.025	8.78	997	12352.66	17.540	8.39	1057	13419.89	18.030	7.91
938	11332.62	17.034	8.78	998	12370.20	17.549	8.38	1058	13437.93	18.037	7.90
939	11349.66	17.042	8.77	999	12387.76	17.557	8.37	1059	13455.97	18.045	7.89
940	11366.70	17.051	8.76	1000	12405.32	17.565	8.37	1060	13474.02	18.053	7.88
941	11383.76	17.060	8.76	1001	12422.89	17.574	8.36	1061	13492.08	18.061	7.87
942	11400.82	17.069	8.75	1002	12440.46	17.582	8.35	1062	13510.14	18.069	7.86
943	11417.90	17.077	8.75	1003	12458.05	17.590	8.34	1063	13528.21	18.077	7.86
944	11434.98	17.086	8.74	1004	12475.64	17.599	8.34	1064	13546.29	18.085	7.85
945	11452.07	17.095	8.73	1005	12493.25	17.607	8.33	1065	13564.38	18.093	7.84
946	11469.17	17.104	8.73	1006	12510.86	17.615	8.32	1066	13582.48	18.100	7.83
947	11486.28	17.112	8.72	1007	12528.48	17.624	8.31	1067	13600.58	18.108	7.82
948	11503.39	17.121	8.72	1008	12546.11	17.632	8.31	1068	13618.70	18.116	7.81
949	11520.52	17.130	8.71	1009	12563.74	17.640	8.30	1069	13636.82	18.124	7.80
950	11537.65	17.138	8.70	1010	12581.39	17.649	8.29	1070	13654.94	18.132	7.79
951	11554.79	17.147	8.70	1011	12599.04	17.657	8.28	1071	13673.08	18.139	7.78
952	11571.95	17.156	8.69	1012	12616.70	17.665	8.28	1072	13691.22	18.147	7.77
953	11589.11	17.165	8.68	1013	12634.37	17.673	8.27	1073	13709.37	18.155	7.77
954	11606.28	17.173	8.68	1014	12652.05	17.682	8.26	1074	13727.53	18.163	7.76
955	11623.45	17.182	8.67	1015	12669.73	17.690	8.25	1075	13745.70	18.170	7.75
956	11640.64	17.191	8.67	1016	12687.43	17.698	8.25	1076	13763.87	18.178	7.74
957	11657.83	17.199	8.66	1017	12705.13	17.706	8.24	1077	13782.06	18.186	7.73
958	11675.04	17.208	8.65	1018	12722.84	17.715	8.23	1078	13800.25	18.194	7.72
959	11692.25	17.216	8.65	1019	12740.56	17.723	8.22	1079	13818.44	18.201	7.71
960	11709.47	17.225	8.64	1020	12758.29	17.731	8.21	1080	13836.65	18.209	7.70

TABLE 4.4.2. *Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1080	13836.65	18.209	7.70	1140	14942.70	18.653	7.07	1200	16074.17	19.055	6.32
1081	13854.86	18.217	7.69	1141	14961.35	18.660	7.06	1201	16093.23	19.062	6.30
1082	13873.08	18.224	7.68	1142	14980.02	18.667	7.05	1202	16112.29	19.068	6.29
1083	13891.31	18.232	7.67	1143	14998.69	18.674	7.04	1203	16131.37	19.074	6.27
1084	13909.55	18.240	7.66	1144	15017.36	18.681	7.03	1204	16150.44	19.081	6.26
1085	13927.79	18.247	7.65	1145	15036.05	18.688	7.02	1205	16169.53	19.087	6.25
1086	13946.04	18.255	7.64	1146	15054.74	18.695	7.00	1206	16188.62	19.093	6.23
1087	13964.30	18.263	7.63	1147	15073.44	18.702	6.99	1207	16207.71	19.099	6.22
1088	13982.57	18.270	7.62	1148	15092.14	18.709	6.98	1208	16226.81	19.105	6.20
1089	14000.84	18.278	7.61	1149	15110.86	18.716	6.97	1209	16245.92	19.112	6.19
1090	14019.12	18.286	7.60	1150	15129.58	18.723	6.96	1210	16265.04	19.118	6.18
1091	14037.41	18.293	7.59	1151	15148.30	18.730	6.95	1211	16284.16	19.124	6.16
1092	14055.71	18.301	7.58	1152	15167.04	18.737	6.93	1212	16303.29	19.130	6.15
1093	14074.01	18.308	7.57	1153	15185.78	18.744	6.92	1213	16322.42	19.136	6.13
1094	14092.33	18.316	7.56	1154	15204.52	18.751	6.91	1214	16341.56	19.142	6.12
1095	14110.65	18.323	7.55	1155	15223.28	18.758	6.90	1215	16360.70	19.149	6.10
1096	14128.97	18.331	7.54	1156	15242.04	18.765	6.89	1216	16379.86	19.155	6.09
1097	14147.31	18.339	7.53	1157	15260.81	18.771	6.87	1217	16399.01	19.161	6.07
1098	14165.65	18.346	7.52	1158	15279.58	18.778	6.86	1218	16418.18	19.167	6.06
1099	14184.00	18.354	7.51	1159	15298.36	18.785	6.85	1219	16437.35	19.173	6.05
1100	14202.36	18.361	7.50	1160	15317.15	18.792	6.84	1220	16456.52	19.179	6.03
1101	14220.72	18.369	7.49	1161	15335.95	18.799	6.83	1221	16475.70	19.185	6.02
1102	14239.09	18.376	7.48	1162	15354.75	18.806	6.81	1222	16494.89	19.191	6.00
1103	14257.47	18.384	7.47	1163	15373.56	18.813	6.80	1223	16514.09	19.197	5.99
1104	14275.86	18.391	7.46	1164	15392.38	18.819	6.79	1224	16533.29	19.203	5.97
1105	14294.26	18.399	7.45	1165	15411.20	18.826	6.78	1225	16552.49	19.209	5.96
1106	14312.66	18.406	7.44	1166	15430.03	18.833	6.76	1226	16571.70	19.215	5.94
1107	14331.07	18.413	7.43	1167	15448.86	18.840	6.75	1227	16590.92	19.221	5.93
1108	14349.49	18.421	7.42	1168	15467.71	18.846	6.74	1228	16610.15	19.227	5.91
1109	14367.91	18.428	7.41	1169	15486.56	18.853	6.73	1229	16629.37	19.233	5.90
1110	14386.34	18.436	7.40	1170	15505.41	18.860	6.71	1230	16648.61	19.238	5.88
1111	14404.78	18.443	7.39	1171	15524.28	18.867	6.70	1231	16667.85	19.244	5.87
1112	14423.23	18.450	7.38	1172	15543.15	18.873	6.69	1232	16687.10	19.250	5.85
1113	14441.68	18.458	7.37	1173	15562.02	18.880	6.68	1233	16706.35	19.256	5.84
1114	14460.14	18.465	7.36	1174	15580.91	18.887	6.66	1234	16725.61	19.262	5.82
1115	14478.61	18.473	7.35	1175	15599.80	18.893	6.65	1235	16744.88	19.268	5.81
1116	14497.09	18.480	7.34	1176	15618.69	18.900	6.64	1236	16764.15	19.273	5.79
1117	14515.57	18.487	7.33	1177	15637.60	18.907	6.62	1237	16783.42	19.279	5.77
1118	14534.06	18.495	7.32	1178	15656.51	18.913	6.61	1238	16802.70	19.285	5.76
1119	14552.56	18.502	7.31	1179	15675.42	18.920	6.60	1239	16821.99	19.291	5.74
1120	14571.07	18.509	7.30	1180	15694.34	18.926	6.59	1240	16841.29	19.296	5.73
1121	14589.58	18.516	7.29	1181	15713.27	18.933	6.57	1241	16860.59	19.302	5.71
1122	14608.10	18.524	7.27	1182	15732.21	18.939	6.56	1242	16879.89	19.308	5.70
1123	14626.63	18.531	7.26	1183	15751.15	18.946	6.55	1243	16899.20	19.314	5.68
1124	14645.16	18.538	7.25	1184	15770.10	18.953	6.53	1244	16918.52	19.319	5.66
1125	14663.70	18.546	7.24	1185	15789.06	18.959	6.52	1245	16937.84	19.325	5.65
1126	14682.25	18.553	7.23	1186	15808.02	18.966	6.51	1246	16957.17	19.331	5.63
1127	14700.81	18.560	7.22	1187	15826.99	18.972	6.49	1247	16976.50	19.336	5.62
1128	14719.37	18.567	7.21	1188	15845.97	18.979	6.48	1248	16995.84	19.342	5.60
1129	14737.94	18.574	7.20	1189	15864.95	18.985	6.47	1249	17015.18	19.347	5.59
1130	14756.52	18.582	7.19	1190	15883.94	18.992	6.45	1250	17034.53	19.353	5.57
1131	14775.11	18.589	7.18	1191	15902.93	18.998	6.44	1251	17053.89	19.359	5.55
1132	14793.70	18.596	7.17	1192	15921.93	19.004	6.43	1252	17073.25	19.364	5.54
1133	14812.30	18.603	7.15	1193	15940.94	19.011	6.41	1253	17092.62	19.370	5.52
1134	14830.91	18.610	7.14	1194	15959.95	19.017	6.40	1254	17111.99	19.375	5.50
1135	14849.52	18.617	7.13	1195	15978.97	19.024	6.39	1255	17131.37	19.381	5.49
1136	14868.14	18.625	7.12	1196	15998.00	19.030	6.37	1256	17150.75	19.386	5.47
1137	14886.77	18.632	7.11	1197	16017.03	19.036	6.36	1257	17170.14	19.392	5.46
1138	14905.40	18.639	7.10	1198	16036.07	19.043	6.34	1258	17189.54	19.397	5.44
1139	14924.05	18.646	7.09	1199	16055.12	19.049	6.33	1259	17208.93	19.402	5.42
1140	14942.70	18.653	7.07	1200	16074.17	19.055	6.32	1260	17228.34	19.408	5.41

TABLE 4.4.2. *Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1260	17228.34	19.408	5.41	1320	18401.92	19.701	4.33	1380	19591.04	19.924	3.09
1261	17247.75	19.413	5.39	1321	18421.63	19.705	4.31	1381	19610.97	19.927	3.06
1262	17267.17	19.419	5.37	1322	18441.33	19.709	4.29	1382	19630.90	19.930	3.04
1263	17286.59	19.424	5.36	1323	18461.04	19.714	4.27	1383	19650.83	19.933	3.02
1264	17306.01	19.429	5.34	1324	18480.76	19.718	4.25	1384	19670.76	19.936	3.00
1265	17325.45	19.435	5.32	1325	18500.48	19.722	4.23	1385	19690.70	19.939	2.98
1266	17344.88	19.440	5.31	1326	18520.20	19.726	4.21	1386	19710.64	19.942	2.95
1267	17364.33	19.445	5.29	1327	18539.93	19.731	4.19	1387	19730.59	19.945	2.93
1268	17383.77	19.451	5.27	1328	18559.67	19.735	4.17	1388	19750.53	19.948	2.91
1269	17403.23	19.456	5.26	1329	18579.40	19.739	4.15	1389	19770.48	19.951	2.89
1270	17422.69	19.461	5.24	1330	18599.14	19.743	4.13	1390	19790.44	19.954	2.86
1271	17442.15	19.466	5.22	1331	18618.89	19.747	4.11	1391	19810.39	19.957	2.84
1272	17461.62	19.472	5.20	1332	18638.64	19.751	4.09	1392	19830.35	19.960	2.82
1273	17481.09	19.477	5.19	1333	18658.39	19.755	4.07	1393	19850.31	19.962	2.80
1274	17500.57	19.482	5.17	1334	18678.15	19.760	4.05	1394	19870.27	19.965	2.77
1275	17520.06	19.487	5.15	1335	18697.91	19.764	4.03	1395	19890.24	19.968	2.75
1276	17539.55	19.492	5.14	1336	18717.68	19.768	4.01	1396	19910.21	19.971	2.73
1277	17559.04	19.497	5.12	1337	18737.45	19.772	3.99	1397	19930.18	19.973	2.71
1278	17578.54	19.502	5.10	1338	18757.22	19.776	3.97	1398	19950.16	19.976	2.68
1279	17598.05	19.508	5.08	1339	18777.00	19.780	3.95	1399	19970.13	19.979	2.66
1280	17617.56	19.513	5.07	1340	18796.78	19.783	3.93	1400	19990.11	19.981	2.64
1281	17637.07	19.518	5.05	1341	18816.56	19.787	3.91	1401	20010.10	19.984	2.61
1282	17656.59	19.523	5.03	1342	18836.35	19.791	3.89	1402	20030.08	19.987	2.59
1283	17676.12	19.528	5.01	1343	18856.15	19.795	3.87	1403	20050.07	19.989	2.57
1284	17695.65	19.533	5.00	1344	18875.94	19.799	3.85	1404	20070.06	19.992	2.55
1285	17715.18	19.538	4.98	1345	18895.74	19.803	3.83	1405	20090.05	19.994	2.52
1286	17734.72	19.543	4.96	1346	18915.55	19.807	3.81	1406	20110.05	19.997	2.50
1287	17754.27	19.548	4.94	1347	18935.36	19.811	3.79	1407	20130.05	19.999	2.48
1288	17773.82	19.553	4.93	1348	18955.17	19.814	3.77	1408	20150.05	20.002	2.45
1289	17793.37	19.557	4.91	1349	18974.99	19.818	3.75	1409	20170.05	20.004	2.43
1290	17812.93	19.562	4.89	1350	18994.81	19.822	3.73	1410	20190.06	20.007	2.41
1291	17832.50	19.567	4.87	1351	19014.63	19.826	3.71	1411	20210.06	20.009	2.38
1292	17852.07	19.572	4.85	1352	19034.46	19.829	3.69	1412	20230.07	20.011	2.36
1293	17871.64	19.577	4.84	1353	19054.29	19.833	3.67	1413	20250.09	20.014	2.34
1294	17891.22	19.582	4.82	1354	19074.12	19.837	3.65	1414	20270.10	20.016	2.31
1295	17910.81	19.587	4.80	1355	19093.96	19.840	3.62	1415	20290.12	20.018	2.29
1296	17930.39	19.591	4.78	1356	19113.80	19.844	3.60	1416	20310.14	20.021	2.27
1297	17949.99	19.596	4.76	1357	19133.65	19.847	3.58	1417	20330.16	20.023	2.24
1298	17969.59	19.601	4.74	1358	19153.50	19.851	3.56	1418	20350.18	20.025	2.22
1299	17989.19	19.606	4.73	1359	19173.35	19.855	3.54	1419	20370.21	20.027	2.20
1300	18008.80	19.610	4.71	1360	19193.21	19.858	3.52	1420	20390.24	20.030	2.17
1301	18028.41	19.615	4.69	1361	19213.07	19.862	3.50	1421	20410.27	20.032	2.15
1302	18048.03	19.620	4.67	1362	19232.93	19.865	3.48	1422	20430.30	20.034	2.12
1303	18067.65	19.624	4.65	1363	19252.80	19.868	3.46	1423	20450.34	20.036	2.10
1304	18087.28	19.629	4.63	1364	19272.67	19.872	3.43	1424	20470.37	20.038	2.08
1305	18106.91	19.634	4.62	1365	19292.54	19.875	3.41	1425	20490.41	20.040	2.05
1306	18126.54	19.638	4.60	1366	19312.42	19.879	3.39	1426	20510.45	20.042	2.03
1307	18146.18	19.643	4.58	1367	19332.30	19.882	3.37	1427	20530.50	20.044	2.01
1308	18165.83	19.647	4.56	1368	19352.18	19.886	3.35	1428	20550.54	20.046	1.98
1309	18185.48	19.652	4.54	1369	19372.07	19.889	3.33	1429	20570.59	20.048	1.96
1310	18205.13	19.657	4.52	1370	19391.96	19.892	3.31	1430	20590.64	20.050	1.93
1311	18224.79	19.661	4.50	1371	19411.85	19.895	3.28	1431	20610.69	20.052	1.91
1312	18244.46	19.666	4.48	1372	19431.75	19.899	3.26	1432	20630.74	20.054	1.89
1313	18264.12	19.670	4.46	1373	19451.65	19.902	3.24	1433	20650.80	20.056	1.86
1314	18283.80	19.674	4.45	1374	19471.55	19.905	3.22	1434	20670.85	20.058	1.84
1315	18303.47	19.679	4.43	1375	19491.46	19.908	3.20	1435	20690.91	20.059	1.81
1316	18323.15	19.683	4.41	1376	19511.37	19.912	3.17	1436	20710.97	20.061	1.79
1317	18342.84	19.688	4.39	1377	19531.28	19.915	3.15	1437	20731.03	20.063	1.77
1318	18362.53	19.692	4.37	1378	19551.20	19.918	3.13	1438	20751.10	20.065	1.74
1319	18382.22	19.696	4.35	1379	19571.12	19.921	3.11	1439	20771.16	20.066	1.72
1320	18401.92	19.701	4.33	1380	19591.04	19.924	3.09	1440	20791.23	20.068	1.69

TABLE 4.4.2. Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1440	20791.23	20.068	1.69	1500	21997.48	20.125	0.19	1560	23204.40	20.090	-1.34
1441	20811.30	20.070	1.67	1501	22017.60	20.125	0.16	1561	23224.49	20.089	-1.37
1442	20831.37	20.072	1.64	1502	22037.73	20.125	0.14	1562	23244.58	20.088	-1.39
1443	20851.44	20.073	1.62	1503	22057.85	20.125	0.11	1563	23264.66	20.086	-1.42
1444	20871.52	20.075	1.59	1504	22077.98	20.126	0.09	1564	23284.75	20.085	-1.44
1445	20891.59	20.076	1.57	1505	22098.10	20.126	0.06	1565	23304.83	20.083	-1.47
1446	20911.67	20.078	1.55	1506	22118.23	20.126	0.04	1566	23324.92	20.082	-1.49
1447	20931.75	20.079	1.52	1507	22138.36	20.126	0.01	1567	23345.00	20.080	-1.52
1448	20951.83	20.081	1.50	1508	22158.48	20.126	-0.01	1568	23365.08	20.079	-1.54
1449	20971.91	20.082	1.47	1509	22178.61	20.126	-0.04	1569	23385.15	20.077	-1.57
1450	20991.99	20.084	1.45	1510	22198.73	20.126	-0.07	1570	23405.23	20.076	-1.59
1451	21012.08	20.085	1.42	1511	22218.86	20.126	-0.09	1571	23425.31	20.074	-1.62
1452	21032.16	20.087	1.40	1512	22238.98	20.125	-0.12	1572	23445.38	20.072	-1.64
1453	21052.25	20.088	1.37	1513	22259.11	20.125	-0.14	1573	23465.45	20.071	-1.67
1454	21072.34	20.089	1.35	1514	22279.24	20.125	-0.17	1574	23485.52	20.069	-1.69
1455	21092.43	20.091	1.32	1515	22299.36	20.125	-0.19	1575	23505.59	20.067	-1.72
1456	21112.52	20.092	1.30	1516	22319.49	20.125	-0.22	1576	23525.66	20.066	-1.74
1457	21132.61	20.093	1.28	1517	22339.61	20.125	-0.25	1577	23545.72	20.064	-1.77
1458	21152.71	20.095	1.25	1518	22359.73	20.124	-0.27	1578	23565.78	20.062	-1.79
1459	21172.80	20.096	1.23	1519	22379.86	20.124	-0.30	1579	23585.84	20.060	-1.82
1460	21192.90	20.097	1.20	1520	22399.98	20.124	-0.32	1580	23605.90	20.058	-1.84
1461	21213.00	20.098	1.18	1521	22420.11	20.123	-0.35	1581	23625.96	20.057	-1.87
1462	21233.10	20.099	1.15	1522	22440.23	20.123	-0.37	1582	23646.02	20.055	-1.89
1463	21253.20	20.101	1.13	1523	22460.35	20.123	-0.40	1583	23666.07	20.053	-1.91
1464	21273.30	20.102	1.10	1524	22480.47	20.122	-0.43	1584	23686.12	20.051	-1.94
1465	21293.40	20.103	1.08	1525	22500.60	20.122	-0.45	1585	23706.17	20.049	-1.96
1466	21313.50	20.104	1.05	1526	22520.72	20.121	-0.48	1586	23726.22	20.047	-1.99
1467	21333.61	20.105	1.03	1527	22540.84	20.121	-0.50	1587	23746.27	20.045	-2.01
1468	21353.71	20.106	1.00	1528	22560.96	20.120	-0.53	1588	23766.31	20.043	-2.04
1469	21373.82	20.107	0.98	1529	22581.08	20.120	-0.55	1589	23786.35	20.041	-2.06
1470	21393.93	20.108	0.95	1530	22601.20	20.119	-0.58	1590	23806.39	20.039	-2.08
1471	21414.04	20.109	0.93	1531	22621.32	20.119	-0.60	1591	23826.43	20.037	-2.11
1472	21434.14	20.110	0.90	1532	22641.44	20.118	-0.63	1592	23846.47	20.035	-2.13
1473	21454.25	20.111	0.88	1533	22661.55	20.117	-0.66	1593	23866.50	20.032	-2.16
1474	21474.37	20.111	0.85	1534	22681.67	20.117	-0.68	1594	23886.53	20.030	-2.18
1475	21494.48	20.112	0.83	1535	22701.79	20.116	-0.71	1595	23906.56	20.028	-2.20
1476	21514.59	20.113	0.80	1536	22721.90	20.115	-0.73	1596	23926.59	20.026	-2.23
1477	21534.70	20.114	0.77	1537	22742.02	20.115	-0.76	1597	23946.61	20.024	-2.25
1478	21554.82	20.115	0.75	1538	22762.13	20.114	-0.78	1598	23966.63	20.021	-2.28
1479	21574.93	20.115	0.72	1539	22782.25	20.113	-0.81	1599	23986.65	20.019	-2.30
1480	21595.05	20.116	0.70	1540	22802.36	20.112	-0.84	1600	24006.67	20.017	-2.32
1481	21615.17	20.117	0.67	1541	22822.47	20.111	-0.86	1601	24026.69	20.014	-2.35
1482	21635.28	20.117	0.65	1542	22842.58	20.110	-0.89	1602	24046.70	20.012	-2.37
1483	21655.40	20.118	0.62	1543	22862.69	20.110	-0.91	1603	24066.71	20.010	-2.39
1484	21675.52	20.119	0.60	1544	22882.80	20.109	-0.94	1604	24086.72	20.007	-2.42
1485	21695.64	20.119	0.57	1545	22902.91	20.108	-0.96	1605	24106.73	20.005	-2.44
1486	21715.76	20.120	0.55	1546	22923.01	20.107	-0.99	1606	24126.73	20.002	-2.46
1487	21735.88	20.120	0.52	1547	22943.12	20.106	-1.01	1607	24146.73	20.000	-2.49
1488	21756.00	20.121	0.50	1548	22963.23	20.105	-1.04	1608	24166.73	19.997	-2.51
1489	21776.12	20.121	0.47	1549	22983.33	20.104	-1.06	1609	24186.73	19.995	-2.53
1490	21796.24	20.122	0.45	1550	23003.43	20.102	-1.09	1610	24206.72	19.992	-2.56
1491	21816.36	20.122	0.42	1551	23023.53	20.101	-1.12	1611	24226.71	19.990	-2.58
1492	21836.49	20.123	0.39	1552	23043.64	20.100	-1.14	1612	24246.70	19.987	-2.60
1493	21856.61	20.123	0.37	1553	23063.74	20.099	-1.17	1613	24266.69	19.985	-2.63
1494	21876.73	20.123	0.34	1554	23083.83	20.098	-1.19	1614	24286.67	19.982	-2.65
1495	21896.86	20.124	0.32	1555	23103.93	20.097	-1.22	1615	24306.65	19.979	-2.67
1496	21916.98	20.124	0.29	1556	23124.03	20.096	-1.24	1616	24326.63	19.977	-2.69
1497	21937.10	20.124	0.27	1557	23144.12	20.094	-1.27	1617	24346.60	19.974	-2.72
1498	21957.23	20.125	0.24	1558	23164.22	20.093	-1.29	1618	24366.58	19.971	-2.74
1499	21977.35	20.125	0.22	1559	23184.31	20.092	-1.32	1619	24386.55	19.968	-2.76
1500	21997.48	20.125	0.19	1560	23204.40	20.090	-1.34	1620	24406.51	19.966	-2.78

TABLE 4.4.2. *Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1620	24406.51	19.966	-2.78	1680	25598.69	19.762	-3.95	1740	26776.78	19.501	-4.61
1621	24426.48	19.963	-2.81	1681	25618.44	19.758	-3.97	1741	26796.28	19.497	-4.61
1622	24446.44	19.960	-2.83	1682	25638.20	19.754	-3.99	1742	26815.77	19.492	-4.62
1623	24466.40	19.957	-2.85	1683	25657.95	19.750	-4.00	1743	26835.26	19.488	-4.62
1624	24486.35	19.954	-2.87	1684	25677.70	19.746	-4.02	1744	26854.74	19.483	-4.63
1625	24506.31	19.951	-2.89	1685	25697.44	19.742	-4.03	1745	26874.23	19.478	-4.63
1626	24526.26	19.949	-2.92	1686	25717.18	19.738	-4.05	1746	26893.70	19.474	-4.63
1627	24546.20	19.946	-2.94	1687	25736.92	19.734	-4.06	1747	26913.17	19.469	-4.64
1628	24566.15	19.943	-2.96	1688	25756.65	19.730	-4.08	1748	26932.64	19.464	-4.64
1629	24586.09	19.940	-2.98	1689	25776.38	19.725	-4.09	1749	26952.10	19.460	-4.64
1630	24606.03	19.937	-3.00	1690	25796.10	19.721	-4.11	1750	26971.56	19.455	-4.64
1631	24625.96	19.934	-3.02	1691	25815.82	19.717	-4.12	1751	26991.01	19.451	-4.65
1632	24645.89	19.931	-3.05	1692	25835.54	19.713	-4.14	1752	27010.46	19.446	-4.65
1633	24665.82	19.928	-3.07	1693	25855.25	19.709	-4.15	1753	27029.90	19.441	-4.65
1634	24685.75	19.925	-3.09	1694	25874.95	19.705	-4.16	1754	27049.34	19.437	-4.65
1635	24705.67	19.921	-3.11	1695	25894.66	19.701	-4.18	1755	27068.78	19.432	-4.65
1636	24725.59	19.918	-3.13	1696	25914.35	19.696	-4.19	1756	27088.21	19.427	-4.65
1637	24745.51	19.915	-3.15	1697	25934.05	19.692	-4.20	1757	27107.63	19.423	-4.66
1638	24765.42	19.912	-3.17	1698	25953.74	19.688	-4.22	1758	27127.05	19.418	-4.66
1639	24785.33	19.909	-3.19	1699	25973.43	19.684	-4.23	1759	27146.47	19.413	-4.66
1640	24805.24	19.906	-3.21	1700	25993.11	19.680	-4.24	1760	27165.88	19.409	-4.66
1641	24825.14	19.902	-3.24	1701	26012.78	19.675	-4.26	1761	27185.29	19.404	-4.66
1642	24845.05	19.899	-3.26	1702	26032.46	19.671	-4.27	1762	27204.69	19.399	-4.66
1643	24864.94	19.896	-3.28	1703	26052.13	19.667	-4.28	1763	27224.08	19.395	-4.65
1644	24884.84	19.893	-3.30	1704	26071.79	19.662	-4.29	1764	27243.48	19.390	-4.65
1645	24904.73	19.889	-3.32	1705	26091.45	19.658	-4.31	1765	27262.86	19.385	-4.65
1646	24924.62	19.886	-3.34	1706	26111.11	19.654	-4.32	1766	27282.25	19.381	-4.65
1647	24944.50	19.883	-3.36	1707	26130.76	19.650	-4.33	1767	27301.63	19.376	-4.65
1648	24964.38	19.879	-3.38	1708	26150.41	19.645	-4.34	1768	27321.00	19.371	-4.65
1649	24984.26	19.876	-3.40	1709	26170.05	19.641	-4.35	1769	27340.37	19.367	-4.64
1650	25004.13	19.872	-3.42	1710	26189.69	19.637	-4.36	1770	27359.73	19.362	-4.64
1651	25024.00	19.869	-3.44	1711	26209.32	19.632	-4.38	1771	27379.09	19.358	-4.64
1652	25043.87	19.866	-3.46	1712	26228.95	19.628	-4.39	1772	27398.45	19.353	-4.63
1653	25063.73	19.862	-3.48	1713	26248.58	19.623	-4.40	1773	27417.80	19.348	-4.63
1654	25083.60	19.859	-3.49	1714	26268.20	19.619	-4.41	1774	27437.14	19.344	-4.63
1655	25103.45	19.855	-3.51	1715	26287.82	19.615	-4.42	1775	27456.49	19.339	-4.62
1656	25123.31	19.852	-3.53	1716	26307.43	19.610	-4.43	1776	27475.82	19.334	-4.62
1657	25143.16	19.848	-3.55	1717	26327.04	19.606	-4.44	1777	27495.15	19.330	-4.61
1658	25163.00	19.845	-3.57	1718	26346.64	19.601	-4.45	1778	27514.48	19.325	-4.61
1659	25182.84	19.841	-3.59	1719	26366.24	19.597	-4.46	1779	27533.80	19.321	-4.60
1660	25202.68	19.837	-3.61	1720	26385.83	19.592	-4.47	1780	27553.12	19.316	-4.60
1661	25222.52	19.834	-3.63	1721	26405.42	19.588	-4.47	1781	27572.44	19.311	-4.59
1662	25242.35	19.830	-3.64	1722	26425.01	19.583	-4.48	1782	27591.75	19.307	-4.58
1663	25262.18	19.826	-3.66	1723	26444.59	19.579	-4.49	1783	27611.05	19.302	-4.58
1664	25282.00	19.823	-3.68	1724	26464.17	19.574	-4.50	1784	27630.35	19.298	-4.57
1665	25301.82	19.819	-3.70	1725	26483.74	19.570	-4.51	1785	27649.65	19.293	-4.56
1666	25321.64	19.815	-3.72	1726	26503.31	19.565	-4.52	1786	27668.94	19.288	-4.56
1667	25341.46	19.812	-3.73	1727	26522.87	19.561	-4.53	1787	27688.22	19.284	-4.55
1668	25361.27	19.808	-3.75	1728	26542.43	19.556	-4.53	1788	27707.50	19.279	-4.54
1669	25381.07	19.804	-3.77	1729	26561.98	19.552	-4.54	1789	27726.78	19.275	-4.53
1670	25400.87	19.800	-3.79	1730	26581.53	19.547	-4.55	1790	27746.05	19.270	-4.52
1671	25420.67	19.797	-3.80	1731	26601.08	19.543	-4.55	1791	27765.32	19.266	-4.51
1672	25440.47	19.793	-3.82	1732	26620.62	19.538	-4.56	1792	27784.58	19.261	-4.50
1673	25460.26	19.789	-3.84	1733	26640.15	19.534	-4.57	1793	27803.84	19.257	-4.49
1674	25480.04	19.785	-3.86	1734	26659.68	19.529	-4.57	1794	27823.10	19.252	-4.48
1675	25499.83	19.781	-3.87	1735	26679.21	19.524	-4.58	1795	27842.35	19.248	-4.47
1676	25519.61	19.777	-3.89	1736	26698.73	19.520	-4.59	1796	27861.59	19.243	-4.46
1677	25539.38	19.773	-3.91	1737	26718.25	19.515	-4.59	1797	27880.84	19.239	-4.45
1678	25559.15	19.770	-3.92	1738	26737.76	19.511	-4.60	1798	27900.07	19.234	-4.44
1679	25578.92	19.766	-3.94	1739	26757.27	19.506	-4.60	1799	27919.30	19.230	-4.43
1680	25598.69	19.762	-3.95	1740	26776.78	19.501	-4.61	1800	27938.53	19.226	-4.41

TABLE 4.4.2. *Type BP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1800	27938.53	19.226	-4.41	1810	28130.57	19.182	-4.27	1820	28322.18	19.140	-4.09
1801	27957.76	19.221	-4.40	1811	28149.75	19.178	-4.26				
1802	27976.97	19.217	-4.39	1812	28168.93	19.174	-4.24				
1803	27996.19	19.212	-4.38	1813	28188.10	19.169	-4.22				
1804	28015.40	19.208	-4.36	1814	28207.26	19.165	-4.20				
1805	28034.60	19.204	-4.35	1815	28226.43	19.161	-4.19				
1806	28053.81	19.199	-4.33	1816	28245.59	19.157	-4.17				
1807	28073.00	19.195	-4.32	1817	28264.74	19.153	-4.15				
1808	28092.20	19.191	-4.30	1818	28283.89	19.148	-4.13				
1809	28111.39	19.186	-4.29	1819	28303.04	19.144	-4.11				
1810	28130.57	19.182	-4.27	1820	28322.18	19.140	-4.09				

TABLE 4.4.3. Thermoelectric values at the fixed points for Type BP thermoelements versus platinum, Pt-67

Fixed point	Temp. °C	E μV	S μV/°C	dS/dT nV/°C ²
Ice point	0.000	0.00	4.819	31.40
Ether TP	26.870	140.41	5.616	27.99
Water BP	100.000	619.02	7.388	20.96
Benzoic TP	122.370	789.39	7.838	19.36
Indium FP	156.634	1068.91	8.465	17.31
Tin FP	231.9681	1752.39	9.640	14.15
Bismuth FP	271.442	2143.64	10.176	13.05
Cadmium FP	321.108	2664.68	10.798	12.06
Lead FP	327.502	2733.97	10.874	11.95
Mercury BP	356.660	3056.07	11.217	11.55
Zinc FP	419.580	3784.23	11.922	10.93
Sulphur BP	444.674	4086.83	12.194	10.76
Cu-Al FP	548.23	5406.32	13.281	10.29
Antimony FP	630.74	6536.89	14.119	10.03
Aluminum FP	660.37	6959.64	14.415	9.94
Silver FP	961.93	11742.73	17.242	8.63
Gold FP	1064.43	13554.07	18.088	7.84
Copper FP	1084.5	13918.67	18.244	7.66
Nickel FP	1455	21092.43	20.091	1.32
Cobalt FP	1494	21876.73	20.123	0.34
Palladium FP	1554	23083.83	20.098	-1.19
Platinum FP	1772	27398.45	19.353	-4.63

TABLE 4.4.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type BP thermoelements versus platinum, Pt-67

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
0 to 200 °C	8	0.2	<0.1	<0.01	<0.01	<0.01
200 to 400 °C	8	0.4	0.1	<0.01	<0.01	<0.01
400 to 600 °C	8	2	0.2	<0.01	<0.01	<0.01
600 to 800 °C	8	6	0.7	<0.01	<0.01	<0.01
800 to 1000 °C	8	15	2	<0.01	<0.01	<0.01
1000 to 1200 °C	8	30	5	0.02	<0.01	<0.01
1200 to 1400 °C	8	60	10	0.03	<0.01	<0.01
1400 to 1600 °C	8	100	20	0.06	<0.01	<0.01
1600 to 1820 °C	8	200	40	0.1	<0.01	<0.01

4.5. Reference Functions and Tables for the Negative Thermoelement, Type BN, a Platinum—6% Rhodium Alloy Versus Platinum, Pt-67

The coefficients for the eighth degree expansion for the thermoelectric voltage of Type BN thermoelements versus Pt-67 are given in table 4.5.1. The errors caused by using reduced bit arithmetic for calculating values of the functions are given in table 4.5.4.

The primary reference values for Type BN thermoelements versus Pt-67 are given in table 4.5.2. Values at selected fixed points are given in table 4.5.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 4.5.1, 4.5.2, and 4.5.3, respectively.

TABLE 4.5.1. Power series expansion for the thermoelectric voltage of Type BN thermoelements versus platinum, Pt-67

Temperature range	Degree	Coefficients	Term
0 to 1820 °C	8	5.0661081008 ...	T
		$9.7920240809 \times 10^{-3}$	T^2
		$-2.1371705669 \times 10^{-5}$	T^3
		$2.9096345602 \times 10^{-8}$	T^4
		$-2.4374352573 \times 10^{-11}$	T^5
		$1.2623801429 \times 10^{-14}$	T^6
		$-3.7387387148 \times 10^{-18}$	T^7
		$4.7918630894 \times 10^{-22}$	T^8

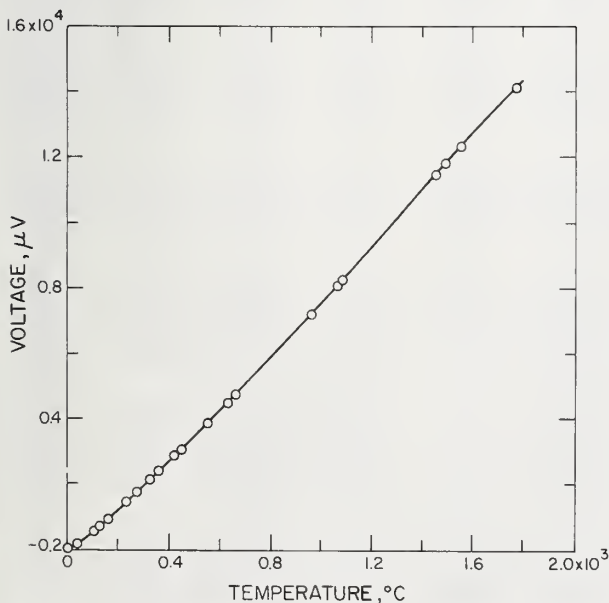


FIGURE 4.5.1. Thermoelectric voltage for Type BN thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

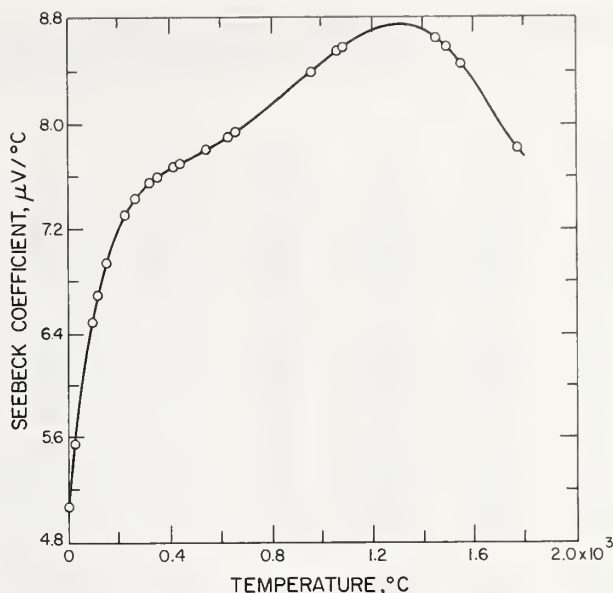


FIGURE 4.5.2. Seebeck coefficient for Type BN thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

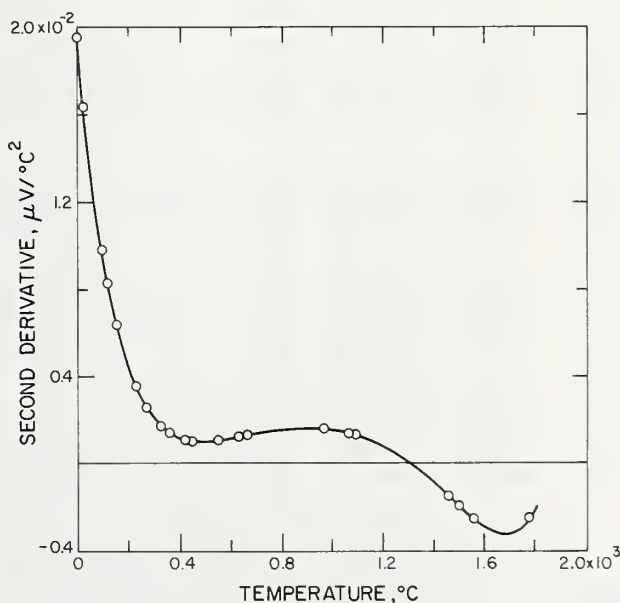


FIGURE 4.5.3. Second derivative of thermoelectric voltage for Type BN thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.00	5.066	19.58	60	334.96	6.034	13.05	120	717.47	6.671	8.46
1	5.01	5.086	19.46	61	341.00	6.047	12.96	121	724.15	6.679	8.39
2	10.17	5.105	19.33	62	347.05	6.060	12.87	122	730.83	6.687	8.33
3	15.29	5.124	19.20	63	353.12	6.073	12.78	123	737.52	6.696	8.27
4	20.42	5.143	19.08	64	359.20	6.085	12.69	124	744.22	6.704	8.21
5	25.57	5.162	18.95	65	365.29	6.098	12.60	125	750.93	6.712	8.15
6	30.74	5.181	18.83	66	371.40	6.111	12.51	126	757.64	6.720	8.09
7	35.94	5.200	18.70	67	377.51	6.123	12.42	127	764.37	6.728	8.03
8	41.14	5.219	18.58	68	383.64	6.135	12.33	128	771.10	6.736	7.97
9	46.37	5.237	18.46	69	389.78	6.148	12.25	129	777.84	6.744	7.91
10	51.62	5.256	18.34	70	395.94	6.160	12.16	130	784.59	6.752	7.85
11	56.88	5.274	18.22	71	402.10	6.172	12.07	131	791.35	6.760	7.79
12	62.17	5.292	18.09	72	408.28	6.184	11.99	132	798.11	6.768	7.73
13	67.47	5.310	17.98	73	414.47	6.196	11.90	133	804.88	6.775	7.67
14	72.79	5.328	17.86	74	420.67	6.208	11.82	134	811.66	6.783	7.61
15	78.12	5.346	17.74	75	426.89	6.220	11.74	135	818.45	6.791	7.56
16	83.48	5.364	17.62	76	433.11	6.231	11.65	136	825.24	6.798	7.50
17	88.85	5.381	17.50	77	439.35	6.243	11.57	137	832.04	6.806	7.44
18	94.24	5.399	17.39	78	445.60	6.255	11.49	138	838.85	6.813	7.39
19	99.65	5.416	17.27	79	451.86	6.266	11.41	139	845.67	6.820	7.33
20	105.07	5.433	17.16	80	458.13	6.277	11.33	140	852.49	6.828	7.27
21	110.51	5.450	17.04	81	464.41	6.289	11.24	141	859.32	6.835	7.22
22	115.97	5.467	16.93	82	470.71	6.300	11.16	142	866.16	6.842	7.17
23	121.45	5.484	16.81	83	477.01	6.311	11.08	143	873.01	6.849	7.11
24	126.94	5.501	16.70	84	483.33	6.322	11.01	144	879.86	6.856	7.06
25	132.45	5.517	16.59	85	489.66	6.333	10.93	145	886.72	6.863	7.00
26	137.98	5.534	16.48	86	496.00	6.344	10.85	146	893.59	6.870	6.95
27	143.52	5.550	16.37	87	502.34	6.355	10.77	147	900.46	6.877	6.90
28	149.08	5.567	16.26	88	508.70	6.365	10.69	148	907.34	6.884	6.84
29	154.65	5.583	16.15	89	515.08	6.376	10.62	149	914.23	6.891	6.79
30	160.24	5.599	16.04	90	521.46	6.387	10.54	150	921.12	6.898	6.74
31	165.85	5.615	15.93	91	527.85	6.397	10.46	151	928.02	6.904	6.69
32	171.47	5.631	15.82	92	534.25	6.408	10.39	152	934.93	6.911	6.64
33	177.11	5.647	15.72	93	540.66	6.418	10.31	153	941.85	6.918	6.59
34	182.77	5.662	15.61	94	547.09	6.428	10.24	154	948.77	6.924	6.54
35	188.44	5.678	15.50	95	553.52	6.438	10.17	155	955.70	6.931	6.49
36	194.12	5.693	15.40	96	559.96	6.449	10.09	156	962.63	6.937	6.44
37	199.82	5.709	15.29	97	566.42	6.459	10.02	157	969.57	6.944	6.39
38	205.54	5.724	15.19	98	572.88	6.469	9.95	158	976.52	6.950	6.34
39	211.27	5.739	15.09	99	579.35	6.478	9.87	159	983.47	6.956	6.29
40	217.02	5.754	14.98	100	585.84	6.488	9.80	160	990.43	6.963	6.24
41	222.78	5.769	14.88	101	592.33	6.498	9.73	161	997.39	6.969	6.19
42	228.55	5.784	14.78	102	598.83	6.508	9.66	162	1004.37	6.975	6.15
43	234.34	5.799	14.68	103	605.35	6.517	9.59	163	1011.34	6.981	6.10
44	240.15	5.813	14.58	104	611.87	6.527	9.52	164	1018.33	6.987	6.05
45	245.97	5.828	14.48	105	618.40	6.536	9.45	165	1025.32	6.993	6.00
46	251.81	5.842	14.38	106	624.94	6.546	9.38	166	1032.32	6.999	5.96
47	257.66	5.856	14.28	107	631.49	6.555	9.31	167	1039.32	7.005	5.91
48	263.52	5.871	14.18	108	638.05	6.564	9.24	168	1046.33	7.011	5.87
49	269.40	5.885	14.08	109	644.62	6.574	9.18	169	1053.34	7.017	5.82
50	275.29	5.899	13.99	110	651.20	6.583	9.11	170	1060.36	7.023	5.78
51	281.19	5.913	13.89	111	657.79	6.592	9.04	171	1067.38	7.028	5.73
52	287.11	5.927	13.79	112	664.38	6.601	8.97	172	1074.42	7.034	5.69
53	293.05	5.940	13.70	113	670.99	6.610	8.91	173	1081.45	7.040	5.64
54	298.99	5.954	13.60	114	677.60	6.619	8.84	174	1088.50	7.045	5.60
55	304.96	5.968	13.51	115	684.23	6.628	8.78	175	1095.54	7.051	5.55
56	310.93	5.981	13.42	116	690.86	6.636	8.71	176	1102.60	7.056	5.51
57	316.92	5.994	13.32	117	697.50	6.645	8.65	177	1109.66	7.062	5.47
58	322.92	6.008	13.23	118	704.15	6.654	8.58	178	1116.72	7.067	5.43
59	328.93	6.021	13.14	119	710.80	6.662	8.52	179	1123.79	7.073	5.38
60	334.96	6.034	13.05	120	717.47	6.671	8.46	180	1130.87	7.078	5.34

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	1130.87	7.078	5.34	240	1563.82	7.333	3.32	300	2008.95	7.492	2.08
181	1137.95	7.083	5.30	241	1571.15	7.337	3.29	301	2016.44	7.494	2.07
182	1145.03	7.089	5.26	242	1578.49	7.340	3.27	302	2023.93	7.496	2.05
183	1152.13	7.094	5.22	243	1585.83	7.343	3.24	303	2031.43	7.498	2.04
184	1159.22	7.099	5.18	244	1593.18	7.346	3.21	304	2038.93	7.500	2.02
185	1166.32	7.104	5.14	245	1600.52	7.350	3.19	305	2046.43	7.502	2.01
186	1173.43	7.109	5.10	246	1607.88	7.353	3.16	306	2053.93	7.504	1.99
187	1180.54	7.115	5.06	247	1615.23	7.356	3.14	307	2061.44	7.506	1.98
188	1187.66	7.120	5.02	248	1622.59	7.359	3.11	308	2068.95	7.508	1.96
189	1194.78	7.125	4.98	249	1629.95	7.362	3.09	309	2076.46	7.510	1.95
190	1201.91	7.130	4.94	250	1637.31	7.365	3.06	310	2083.97	7.512	1.94
191	1209.04	7.134	4.90	251	1644.68	7.368	3.04	311	2091.48	7.514	1.92
192	1216.18	7.139	4.86	252	1652.05	7.371	3.02	312	2099.00	7.516	1.91
193	1223.32	7.144	4.82	253	1659.42	7.374	2.99	313	2106.51	7.518	1.89
194	1230.47	7.149	4.78	254	1666.80	7.377	2.97	314	2114.03	7.520	1.88
195	1237.62	7.154	4.75	255	1674.18	7.380	2.95	315	2121.55	7.522	1.87
196	1244.77	7.158	4.71	256	1681.56	7.383	2.92	316	2129.07	7.523	1.85
197	1251.93	7.163	4.67	257	1688.94	7.386	2.90	317	2136.60	7.525	1.84
198	1259.10	7.168	4.63	258	1696.33	7.389	2.88	318	2144.13	7.527	1.83
199	1266.27	7.172	4.60	259	1703.72	7.392	2.85	319	2151.65	7.529	1.82
200	1273.44	7.177	4.56	260	1711.11	7.395	2.83	320	2159.18	7.531	1.80
201	1280.62	7.182	4.53	261	1718.51	7.397	2.81	321	2166.71	7.533	1.79
202	1287.81	7.186	4.49	262	1725.91	7.400	2.79	322	2174.25	7.534	1.78
203	1295.00	7.191	4.45	263	1733.31	7.403	2.77	323	2181.78	7.536	1.77
204	1302.19	7.195	4.42	264	1740.71	7.406	2.74	324	2189.32	7.538	1.75
205	1309.39	7.199	4.38	265	1748.12	7.409	2.72	325	2196.86	7.540	1.74
206	1316.59	7.204	4.35	266	1755.53	7.411	2.70	326	2204.40	7.541	1.73
207	1323.79	7.208	4.32	267	1762.94	7.414	2.68	327	2211.94	7.543	1.72
208	1331.00	7.212	4.28	268	1770.36	7.417	2.66	328	2219.49	7.545	1.71
209	1338.22	7.217	4.25	269	1777.78	7.419	2.64	329	2227.03	7.547	1.70
210	1345.44	7.221	4.21	270	1785.20	7.422	2.62	330	2234.58	7.548	1.68
211	1352.66	7.225	4.18	271	1792.62	7.424	2.60	331	2242.13	7.550	1.67
212	1359.89	7.229	4.15	272	1800.05	7.427	2.58	332	2249.68	7.552	1.66
213	1367.12	7.233	4.11	273	1807.47	7.430	2.56	333	2257.23	7.553	1.65
214	1374.35	7.237	4.08	274	1814.91	7.432	2.54	334	2264.79	7.555	1.64
215	1381.59	7.242	4.05	275	1822.34	7.435	2.52	335	2272.34	7.556	1.63
216	1388.84	7.246	4.02	276	1829.77	7.437	2.50	336	2279.90	7.558	1.62
217	1396.08	7.250	3.99	277	1837.21	7.440	2.48	337	2287.46	7.560	1.61
218	1403.34	7.254	3.95	278	1844.65	7.442	2.46	338	2295.02	7.561	1.60
219	1410.59	7.257	3.92	279	1852.10	7.445	2.44	339	2302.58	7.563	1.59
220	1417.85	7.261	3.89	280	1859.54	7.447	2.42	340	2310.14	7.564	1.58
221	1425.11	7.265	3.86	281	1866.99	7.449	2.40	341	2317.71	7.566	1.57
222	1432.38	7.269	3.83	282	1874.44	7.452	2.39	342	2325.28	7.568	1.56
223	1439.65	7.273	3.80	283	1881.90	7.454	2.37	343	2332.84	7.569	1.55
224	1446.93	7.277	3.77	284	1889.35	7.457	2.35	344	2340.41	7.571	1.54
225	1454.21	7.280	3.74	285	1896.81	7.459	2.33	345	2347.99	7.572	1.53
226	1461.49	7.284	3.71	286	1904.27	7.461	2.31	346	2355.56	7.574	1.52
227	1468.77	7.288	3.68	287	1911.73	7.464	2.30	347	2363.13	7.575	1.51
228	1476.06	7.292	3.65	288	1919.20	7.466	2.28	348	2370.71	7.577	1.50
229	1483.36	7.295	3.62	289	1926.66	7.468	2.26	349	2378.29	7.578	1.49
230	1490.65	7.299	3.59	290	1934.13	7.470	2.24	350	2385.87	7.580	1.48
231	1497.95	7.302	3.56	291	1941.60	7.473	2.23	351	2393.45	7.581	1.47
232	1505.26	7.306	3.54	292	1949.08	7.475	2.21	352	2401.03	7.583	1.46
233	1512.57	7.309	3.51	293	1956.55	7.477	2.19	353	2408.61	7.584	1.46
234	1519.88	7.313	3.48	294	1964.03	7.479	2.18	354	2416.20	7.586	1.45
235	1527.19	7.316	3.45	295	1971.51	7.481	2.16	355	2423.78	7.587	1.44
236	1534.51	7.320	3.43	296	1978.99	7.484	2.15	356	2431.37	7.589	1.43
237	1541.83	7.323	3.40	297	1986.48	7.486	2.13	357	2438.96	7.590	1.42
238	1549.16	7.327	3.37	298	1993.97	7.488	2.11	358	2446.55	7.591	1.41
239	1556.48	7.330	3.34	299	2001.45	7.490	2.10	359	2454.14	7.593	1.41
240	1563.82	7.333	3.32	300	2008.95	7.492	2.08	360	2461.74	7.594	1.40

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	2461.74	7.594	1.40	420	2919.67	7.667	1.08	480	3381.56	7.729	1.00
361	2469.33	7.596	1.39	421	2927.33	7.668	1.08	481	3389.29	7.730	1.00
362	2476.93	7.597	1.38	422	2935.00	7.669	1.08	482	3397.02	7.731	1.00
363	2484.52	7.598	1.37	423	2942.67	7.670	1.07	483	3404.75	7.732	1.00
364	2492.12	7.600	1.37	424	2950.34	7.671	1.07	484	3412.48	7.733	1.00
365	2499.72	7.601	1.36	425	2958.02	7.672	1.07	485	3420.21	7.734	1.00
366	2507.33	7.602	1.35	426	2965.69	7.673	1.06	486	3427.95	7.735	1.00
367	2514.93	7.604	1.34	427	2973.36	7.675	1.06	487	3435.68	7.736	1.00
368	2522.53	7.605	1.34	428	2981.04	7.676	1.06	488	3443.42	7.737	1.00
369	2530.14	7.606	1.33	429	2988.71	7.677	1.06	489	3451.16	7.738	1.00
370	2537.75	7.608	1.32	430	2996.39	7.678	1.05	490	3458.89	7.739	1.00
371	2545.35	7.609	1.32	431	3004.07	7.679	1.05	491	3466.63	7.740	1.00
372	2552.96	7.610	1.31	432	3011.75	7.680	1.05	492	3474.37	7.741	1.00
373	2560.58	7.612	1.30	433	3019.43	7.681	1.05	493	3482.11	7.742	1.00
374	2568.19	7.613	1.30	434	3027.11	7.682	1.04	494	3489.86	7.743	1.00
375	2575.80	7.614	1.29	435	3034.79	7.683	1.04	495	3497.60	7.744	1.00
376	2583.42	7.616	1.28	436	3042.48	7.684	1.04	496	3505.34	7.745	1.00
377	2591.03	7.617	1.28	437	3050.16	7.685	1.04	497	3513.09	7.746	1.00
378	2598.65	7.618	1.27	438	3057.85	7.686	1.04	498	3520.84	7.747	1.00
379	2606.27	7.619	1.26	439	3065.53	7.687	1.03	499	3528.58	7.748	1.00
380	2613.89	7.621	1.26	440	3073.22	7.688	1.03	500	3536.33	7.749	1.00
381	2621.51	7.622	1.25	441	3080.91	7.689	1.03	501	3544.08	7.750	1.00
382	2629.13	7.623	1.25	442	3088.60	7.690	1.03	502	3551.83	7.751	1.01
383	2636.76	7.624	1.24	443	3096.29	7.691	1.03	503	3559.58	7.752	1.01
384	2644.38	7.626	1.24	444	3103.98	7.692	1.03	504	3567.33	7.753	1.01
385	2652.01	7.627	1.23	445	3111.67	7.693	1.02	505	3575.09	7.754	1.01
386	2659.64	7.628	1.22	446	3119.37	7.694	1.02	506	3582.84	7.755	1.01
387	2667.26	7.629	1.22	447	3127.06	7.695	1.02	507	3590.59	7.756	1.01
388	2674.89	7.631	1.21	448	3134.76	7.696	1.02	508	3598.35	7.757	1.01
389	2682.53	7.632	1.21	449	3142.46	7.697	1.02	509	3606.11	7.758	1.01
390	2690.16	7.633	1.20	450	3150.15	7.698	1.02	510	3613.87	7.759	1.01
391	2697.79	7.634	1.20	451	3157.85	7.699	1.02	511	3621.62	7.760	1.01
392	2705.43	7.635	1.19	452	3165.55	7.700	1.01	512	3629.38	7.761	1.01
393	2713.06	7.637	1.19	453	3173.25	7.701	1.01	513	3637.15	7.762	1.01
394	2720.70	7.638	1.18	454	3180.96	7.702	1.01	514	3644.91	7.763	1.02
395	2728.34	7.639	1.18	455	3188.66	7.703	1.01	515	3652.67	7.764	1.02
396	2735.98	7.640	1.17	456	3196.36	7.704	1.01	516	3660.44	7.765	1.02
397	2743.62	7.641	1.17	457	3204.07	7.705	1.01	517	3668.20	7.766	1.02
398	2751.26	7.642	1.16	458	3211.77	7.707	1.01	518	3675.97	7.767	1.02
399	2758.90	7.644	1.16	459	3219.48	7.708	1.01	519	3683.73	7.768	1.02
400	2766.55	7.645	1.15	460	3227.19	7.709	1.01	520	3691.50	7.769	1.02
401	2774.19	7.646	1.15	461	3234.90	7.710	1.01	521	3699.27	7.770	1.02
402	2781.84	7.647	1.15	462	3242.61	7.711	1.00	522	3707.04	7.771	1.02
403	2789.49	7.648	1.14	463	3250.32	7.712	1.00	523	3714.81	7.772	1.03
404	2797.13	7.649	1.14	464	3258.03	7.713	1.00	524	3722.59	7.773	1.03
405	2804.78	7.650	1.13	465	3265.74	7.714	1.00	525	3730.36	7.774	1.03
406	2812.44	7.652	1.13	466	3273.46	7.715	1.00	526	3738.13	7.775	1.03
407	2820.09	7.653	1.13	467	3281.17	7.716	1.00	527	3745.91	7.776	1.03
408	2827.74	7.654	1.12	468	3288.89	7.717	1.00	528	3753.69	7.777	1.03
409	2835.40	7.655	1.12	469	3296.61	7.718	1.00	529	3761.46	7.778	1.03
410	2843.05	7.656	1.11	470	3304.32	7.719	1.00	530	3769.24	7.779	1.03
411	2850.71	7.657	1.11	471	3312.04	7.720	1.00	531	3777.02	7.780	1.04
412	2858.37	7.658	1.11	472	3319.76	7.721	1.00	532	3784.80	7.781	1.04
413	2866.02	7.659	1.10	473	3327.48	7.722	1.00	533	3792.58	7.782	1.04
414	2873.68	7.661	1.10	474	3335.21	7.723	1.00	534	3800.37	7.783	1.04
415	2881.35	7.662	1.10	475	3342.93	7.724	1.00	535	3808.15	7.784	1.04
416	2889.01	7.663	1.09	476	3350.65	7.725	1.00	536	3815.93	7.785	1.04
417	2896.67	7.664	1.09	477	3358.38	7.726	1.00	537	3823.72	7.786	1.04
418	2904.34	7.665	1.09	478	3366.10	7.727	1.00	538	3831.51	7.787	1.05
419	2912.00	7.666	1.08	479	3373.83	7.728	1.00	539	3839.30	7.788	1.05
420	2919.67	7.667	1.08	480	3381.56	7.729	1.00	540	3847.08	7.789	1.05

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	3847.08	7.789	1.05	600	4316.41	7.856	1.17	660	4789.94	7.930	1.31
541	3854.87	7.791	1.05	601	4324.26	7.857	1.17	661	4797.87	7.931	1.31
542	3862.67	7.792	1.05	602	4332.12	7.858	1.17	662	4805.80	7.933	1.31
543	3870.46	7.793	1.05	603	4339.98	7.859	1.17	663	4813.74	7.934	1.31
544	3878.25	7.794	1.06	604	4347.84	7.860	1.18	664	4821.67	7.935	1.32
545	3886.04	7.795	1.06	605	4355.70	7.862	1.18	665	4829.61	7.937	1.32
546	3893.84	7.796	1.06	606	4363.56	7.863	1.18	666	4837.54	7.938	1.32
547	3901.64	7.797	1.06	607	4371.43	7.864	1.18	667	4845.48	7.939	1.32
548	3909.43	7.798	1.06	608	4379.29	7.865	1.19	668	4853.42	7.941	1.33
549	3917.23	7.799	1.06	609	4387.16	7.866	1.19	669	4861.36	7.942	1.33
550	3925.03	7.800	1.07	610	4395.02	7.868	1.19	670	4869.31	7.943	1.33
551	3932.83	7.801	1.07	611	4402.89	7.869	1.19	671	4877.25	7.945	1.33
552	3940.63	7.802	1.07	612	4410.76	7.870	1.20	672	4885.19	7.946	1.33
553	3948.44	7.803	1.07	613	4418.63	7.871	1.20	673	4893.14	7.947	1.34
554	3956.24	7.804	1.07	614	4426.50	7.872	1.20	674	4901.09	7.949	1.34
555	3964.05	7.805	1.07	615	4434.38	7.874	1.20	675	4909.04	7.950	1.34
556	3971.85	7.806	1.08	616	4442.25	7.875	1.20	676	4916.99	7.951	1.34
557	3979.66	7.808	1.08	617	4450.13	7.876	1.21	677	4924.94	7.953	1.35
558	3987.47	7.809	1.08	618	4458.00	7.877	1.21	678	4932.89	7.954	1.35
559	3995.28	7.810	1.08	619	4465.88	7.878	1.21	679	4940.85	7.955	1.35
560	4003.09	7.811	1.08	620	4473.76	7.880	1.21	680	4948.80	7.957	1.35
561	4010.90	7.812	1.09	621	4481.64	7.881	1.22	681	4956.76	7.958	1.35
562	4018.71	7.813	1.09	622	4489.52	7.882	1.22	682	4964.72	7.959	1.36
563	4026.52	7.814	1.09	623	4497.40	7.883	1.22	683	4972.68	7.961	1.36
564	4034.34	7.815	1.09	624	4505.29	7.884	1.22	684	4980.64	7.962	1.36
565	4042.15	7.816	1.09	625	4513.17	7.886	1.23	685	4988.60	7.963	1.36
566	4049.97	7.817	1.10	626	4521.06	7.887	1.23	686	4996.57	7.965	1.37
567	4057.79	7.818	1.10	627	4528.95	7.888	1.23	687	5004.53	7.966	1.37
568	4065.61	7.820	1.10	628	4536.83	7.889	1.23	688	5012.50	7.968	1.37
569	4073.43	7.821	1.10	629	4544.72	7.891	1.23	689	5020.47	7.969	1.37
570	4081.25	7.822	1.10	630	4552.62	7.892	1.24	690	5028.44	7.970	1.37
571	4089.07	7.823	1.11	631	4560.51	7.893	1.24	691	5036.41	7.972	1.38
572	4096.89	7.824	1.11	632	4568.40	7.894	1.24	692	5044.38	7.973	1.38
573	4104.72	7.825	1.11	633	4576.30	7.896	1.24	693	5052.36	7.974	1.38
574	4112.54	7.826	1.11	634	4584.19	7.897	1.25	694	5060.33	7.976	1.38
575	4120.37	7.827	1.11	635	4592.09	7.898	1.25	695	5068.31	7.977	1.39
576	4128.20	7.828	1.12	636	4599.99	7.899	1.25	696	5076.28	7.979	1.39
577	4136.03	7.830	1.12	637	4607.89	7.901	1.25	697	5084.26	7.980	1.39
578	4143.86	7.831	1.12	638	4615.79	7.902	1.26	698	5092.24	7.981	1.39
579	4151.69	7.832	1.12	639	4623.69	7.903	1.26	699	5100.23	7.983	1.39
580	4159.52	7.833	1.12	640	4631.60	7.904	1.26	700	5108.21	7.984	1.40
581	4167.35	7.834	1.13	641	4639.50	7.906	1.26	701	5116.19	7.986	1.40
582	4175.19	7.835	1.13	642	4647.41	7.907	1.27	702	5124.18	7.987	1.40
583	4183.02	7.836	1.13	643	4655.32	7.908	1.27	703	5132.17	7.988	1.40
584	4190.86	7.837	1.13	644	4663.22	7.909	1.27	704	5140.16	7.990	1.40
585	4198.70	7.839	1.13	645	4671.13	7.911	1.27	705	5148.15	7.991	1.41
586	4206.54	7.840	1.14	646	4679.05	7.912	1.27	706	5156.14	7.993	1.41
587	4214.38	7.841	1.14	647	4686.96	7.913	1.28	707	5164.13	7.994	1.41
588	4222.22	7.842	1.14	648	4694.87	7.915	1.28	708	5172.13	7.995	1.41
589	4230.06	7.843	1.14	649	4702.79	7.916	1.28	709	5180.12	7.997	1.42
590	4237.91	7.844	1.15	650	4710.70	7.917	1.28	710	5188.12	7.998	1.42
591	4245.75	7.845	1.15	651	4718.62	7.918	1.29	711	5196.12	8.000	1.42
592	4253.60	7.847	1.15	652	4726.54	7.920	1.29	712	5204.12	8.001	1.42
593	4261.44	7.848	1.15	653	4734.46	7.921	1.29	713	5212.12	8.002	1.42
594	4269.29	7.849	1.15	654	4742.38	7.922	1.29	714	5220.13	8.004	1.43
595	4277.14	7.850	1.16	655	4750.31	7.924	1.30	715	5228.13	8.005	1.43
596	4284.99	7.851	1.16	656	4758.23	7.925	1.30	716	5236.14	8.007	1.43
597	4292.84	7.852	1.16	657	4766.15	7.926	1.30	717	5244.14	8.008	1.43
598	4300.70	7.853	1.16	658	4774.08	7.927	1.30	718	5252.15	8.010	1.43
599	4308.55	7.855	1.17	659	4782.01	7.929	1.30	719	5260.16	8.011	1.44
600	4316.41	7.856	1.17	660	4789.94	7.930	1.31	720	5268.17	8.012	1.44

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	5268.17	8.012	1.44	780	5751.58	8.102	1.54	840	6240.51	8.197	1.61
721	5276.19	8.014	1.44	781	5759.68	8.104	1.54	841	6248.71	8.198	1.61
722	5284.20	8.015	1.44	782	5767.78	8.105	1.54	842	6256.91	8.200	1.61
723	5292.22	8.017	1.44	783	5775.89	8.107	1.55	843	6265.11	8.201	1.61
724	5300.24	8.018	1.45	784	5784.00	8.108	1.55	844	6273.31	8.203	1.61
725	5308.25	8.020	1.45	785	5792.10	8.110	1.55	845	6281.52	8.205	1.61
726	5316.27	8.021	1.45	786	5800.21	8.111	1.55	846	6289.72	8.206	1.61
727	5324.30	8.023	1.45	787	5808.33	8.113	1.55	847	6297.93	8.208	1.61
728	5332.32	8.024	1.45	788	5816.44	8.114	1.55	848	6306.14	8.209	1.61
729	5340.34	8.025	1.45	789	5824.56	8.116	1.55	849	6314.35	8.211	1.61
730	5348.37	8.027	1.46	790	5832.67	8.117	1.55	850	6322.56	8.213	1.61
731	5356.40	8.028	1.46	791	5840.79	8.119	1.56	851	6330.77	8.214	1.61
732	5364.43	8.030	1.46	792	5848.91	8.121	1.56	852	6338.99	8.216	1.61
733	5372.46	8.031	1.46	793	5857.03	8.122	1.56	853	6347.21	8.218	1.62
734	5380.49	8.033	1.46	794	5865.15	8.124	1.56	854	6355.42	8.219	1.62
735	5388.52	8.034	1.47	795	5873.28	8.125	1.56	855	6363.64	8.221	1.62
736	5396.56	8.036	1.47	796	5881.41	8.127	1.56	856	6371.87	8.222	1.62
737	5404.59	8.037	1.47	797	5889.53	8.128	1.56	857	6380.09	8.224	1.62
738	5412.63	8.039	1.47	798	5897.66	8.130	1.57	858	6388.31	8.226	1.62
739	5420.67	8.040	1.47	799	5905.79	8.131	1.57	859	6396.54	8.227	1.62
740	5428.71	8.042	1.48	800	5913.92	8.133	1.57	860	6404.77	8.229	1.62
741	5436.76	8.043	1.48	801	5922.06	8.135	1.57	861	6413.00	8.231	1.62
742	5444.80	8.045	1.48	802	5930.19	8.136	1.57	862	6421.23	8.232	1.62
743	5452.84	8.046	1.48	803	5938.33	8.138	1.57	863	6429.46	8.234	1.62
744	5460.89	8.048	1.48	804	5946.47	8.139	1.57	864	6437.70	8.235	1.62
745	5468.94	8.049	1.48	805	5954.61	8.141	1.57	865	6445.93	8.237	1.62
746	5476.99	8.050	1.49	806	5962.75	8.142	1.57	866	6454.17	8.239	1.62
747	5485.04	8.052	1.49	807	5970.89	8.144	1.58	867	6462.41	8.240	1.62
748	5493.09	8.053	1.49	808	5979.04	8.146	1.58	868	6470.65	8.242	1.62
749	5501.15	8.055	1.49	809	5987.19	8.147	1.58	869	6478.89	8.243	1.62
750	5509.20	8.056	1.49	810	5995.33	8.149	1.58	870	6487.14	8.245	1.62
751	5517.26	8.058	1.50	811	6003.48	8.150	1.58	871	6495.38	8.247	1.62
752	5525.32	8.059	1.50	812	6011.63	8.152	1.58	872	6503.63	8.248	1.62
753	5533.38	8.061	1.50	813	6019.79	8.154	1.58	873	6511.88	8.250	1.62
754	5541.44	8.062	1.50	814	6027.94	8.155	1.58	874	6520.13	8.252	1.62
755	5549.50	8.064	1.50	815	6036.10	8.157	1.58	875	6528.38	8.253	1.62
756	5557.57	8.065	1.50	816	6044.26	8.158	1.59	876	6536.64	8.255	1.63
757	5565.63	8.067	1.51	817	6052.41	8.160	1.59	877	6544.89	8.256	1.63
758	5573.70	8.068	1.51	818	6060.57	8.161	1.59	878	6553.15	8.258	1.63
759	5581.77	8.070	1.51	819	6068.74	8.163	1.59	879	6561.41	8.260	1.63
760	5589.84	8.071	1.51	820	6076.90	8.165	1.59	880	6569.67	8.261	1.63
761	5597.91	8.073	1.51	821	6085.07	8.166	1.59	881	6577.93	8.263	1.63
762	5605.99	8.074	1.51	822	6093.23	8.168	1.59	882	6586.20	8.265	1.63
763	5614.06	8.076	1.52	823	6101.40	8.169	1.59	883	6594.46	8.266	1.63
764	5622.14	8.078	1.52	824	6109.57	8.171	1.59	884	6602.73	8.268	1.63
765	5630.22	8.079	1.52	825	6117.74	8.173	1.59	885	6611.00	8.269	1.63
766	5638.30	8.081	1.52	826	6125.92	8.174	1.60	886	6619.27	8.271	1.63
767	5646.38	8.082	1.52	827	6134.09	8.176	1.60	887	6627.54	8.273	1.63
768	5654.46	8.084	1.52	828	6142.27	8.177	1.60	888	6635.81	8.274	1.63
769	5662.55	8.085	1.52	829	6150.45	8.179	1.60	889	6644.09	8.276	1.63
770	5670.63	8.087	1.53	830	6158.63	8.181	1.60	890	6652.37	8.278	1.63
771	5678.72	8.088	1.53	831	6166.81	8.182	1.60	891	6660.64	8.279	1.63
772	5686.81	8.090	1.53	832	6174.99	8.184	1.60	892	6668.92	8.281	1.63
773	5694.90	8.091	1.53	833	6183.18	8.185	1.60	893	6677.21	8.283	1.63
774	5702.99	8.093	1.53	834	6191.36	8.187	1.60	894	6685.49	8.284	1.63
775	5711.08	8.094	1.53	835	6199.55	8.189	1.60	895	6693.77	8.286	1.63
776	5719.18	8.096	1.54	836	6207.74	8.190	1.60	896	6702.06	8.287	1.63
777	5727.28	8.097	1.54	837	6215.93	8.192	1.60	897	6710.35	8.289	1.63
778	5735.37	8.099	1.54	838	6224.12	8.193	1.61	898	6718.64	8.291	1.63
779	5743.47	8.100	1.54	839	6232.32	8.195	1.61	899	6726.93	8.292	1.63
780	5751.58	8.102	1.54	840	6240.51	8.197	1.61	900	6735.22	8.294	1.63

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	6735.22	8.294	1.63	960	7235.78	8.391	1.60	1020	7742.06	8.484	1.51
901	6743.52	8.296	1.63	961	7244.17	8.393	1.60	1021	7750.55	8.486	1.51
902	6751.81	8.297	1.63	962	7252.56	8.394	1.59	1022	7759.03	8.487	1.50
903	6760.11	8.299	1.63	963	7260.96	8.396	1.59	1023	7767.52	8.489	1.50
904	6768.41	8.300	1.63	964	7269.35	8.397	1.59	1024	7776.01	8.490	1.50
905	6776.71	8.302	1.63	965	7277.75	8.399	1.59	1025	7784.50	8.492	1.50
906	6785.02	8.304	1.63	966	7286.15	8.400	1.59	1026	7793.00	8.493	1.50
907	6793.32	8.305	1.63	967	7294.55	8.402	1.59	1027	7801.49	8.495	1.49
908	6801.63	8.307	1.63	968	7302.95	8.404	1.59	1028	7809.98	8.496	1.49
909	6809.93	8.309	1.63	969	7311.36	8.405	1.59	1029	7818.48	8.498	1.49
910	6818.24	8.310	1.63	970	7319.77	8.407	1.59	1030	7826.98	8.499	1.49
911	6826.55	8.312	1.63	971	7328.17	8.408	1.59	1031	7835.48	8.501	1.48
912	6834.87	8.313	1.63	972	7336.58	8.410	1.58	1032	7843.98	8.502	1.48
913	6843.18	8.315	1.63	973	7344.99	8.412	1.58	1033	7852.49	8.504	1.48
914	6851.50	8.317	1.63	974	7353.41	8.413	1.58	1034	7860.99	8.505	1.48
915	6859.81	8.318	1.63	975	7361.82	8.415	1.58	1035	7869.50	8.507	1.48
916	6868.13	8.320	1.62	976	7370.23	8.416	1.58	1036	7878.00	8.508	1.47
917	6876.45	8.322	1.62	977	7378.65	8.418	1.58	1037	7886.51	8.510	1.47
918	6884.78	8.323	1.62	978	7387.07	8.419	1.58	1038	7895.02	8.511	1.47
919	6893.10	8.325	1.62	979	7395.49	8.421	1.58	1039	7903.53	8.513	1.47
920	6901.43	8.326	1.62	980	7403.91	8.423	1.57	1040	7912.05	8.514	1.46
921	6909.75	8.328	1.62	981	7412.34	8.424	1.57	1041	7920.56	8.516	1.46
922	6918.08	8.330	1.62	982	7420.76	8.426	1.57	1042	7929.08	8.517	1.46
923	6926.41	8.331	1.62	983	7429.19	8.427	1.57	1043	7937.60	8.518	1.46
924	6934.74	8.333	1.62	984	7437.62	8.429	1.57	1044	7946.12	8.520	1.45
925	6943.08	8.335	1.62	985	7446.05	8.430	1.57	1045	7954.64	8.521	1.45
926	6951.41	8.336	1.62	986	7454.48	8.432	1.57	1046	7963.16	8.523	1.45
927	6959.75	8.338	1.62	987	7462.91	8.434	1.56	1047	7971.68	8.524	1.45
928	6968.09	8.339	1.62	988	7471.34	8.435	1.56	1048	7980.21	8.526	1.44
929	6976.43	8.341	1.62	989	7479.78	8.437	1.56	1049	7988.73	8.527	1.44
930	6984.77	8.343	1.62	990	7488.22	8.438	1.56	1050	7997.26	8.529	1.44
931	6993.11	8.344	1.62	991	7496.66	8.440	1.56	1051	8005.79	8.530	1.44
932	7001.46	8.346	1.62	992	7505.10	8.441	1.56	1052	8014.32	8.531	1.43
933	7009.81	8.347	1.62	993	7513.54	8.443	1.56	1053	8022.85	8.533	1.43
934	7018.15	8.349	1.62	994	7521.98	8.445	1.55	1054	8031.39	8.534	1.43
935	7026.50	8.351	1.62	995	7530.43	8.446	1.55	1055	8039.92	8.536	1.43
936	7034.86	8.352	1.62	996	7538.88	8.448	1.55	1056	8048.46	8.537	1.42
937	7043.21	8.354	1.62	997	7547.32	8.449	1.55	1057	8057.00	8.539	1.42
938	7051.56	8.356	1.61	998	7555.77	8.451	1.55	1058	8065.54	8.540	1.42
939	7059.92	8.357	1.61	999	7564.23	8.452	1.55	1059	8074.08	8.541	1.42
940	7068.28	8.359	1.61	1000	7572.68	8.454	1.54	1060	8082.62	8.543	1.41
941	7076.64	8.360	1.61	1001	7581.13	8.455	1.54	1061	8091.16	8.544	1.41
942	7085.00	8.362	1.61	1002	7589.59	8.457	1.54	1062	8099.71	8.546	1.41
943	7093.36	8.364	1.61	1003	7598.05	8.458	1.54	1063	8108.25	8.547	1.40
944	7101.73	8.365	1.61	1004	7606.51	8.460	1.54	1064	8116.80	8.549	1.40
945	7110.09	8.367	1.61	1005	7614.97	8.462	1.54	1065	8125.35	8.550	1.40
946	7118.46	8.368	1.61	1006	7623.43	8.463	1.53	1066	8133.90	8.551	1.40
947	7126.83	8.370	1.61	1007	7631.89	8.465	1.53	1067	8142.45	8.553	1.39
948	7135.20	8.372	1.61	1008	7640.36	8.466	1.53	1068	8151.01	8.554	1.39
949	7143.57	8.373	1.61	1009	7648.83	8.468	1.53	1069	8159.56	8.555	1.39
950	7151.95	8.375	1.61	1010	7657.29	8.469	1.53	1070	8168.12	8.557	1.38
951	7160.32	8.377	1.61	1011	7665.76	8.471	1.53	1071	8176.68	8.558	1.38
952	7168.70	8.378	1.60	1012	7674.24	8.472	1.52	1072	8185.24	8.560	1.38
953	7177.08	8.380	1.60	1013	7682.71	8.474	1.52	1073	8193.80	8.561	1.37
954	7185.46	8.381	1.60	1014	7691.18	8.475	1.52	1074	8202.36	8.562	1.37
955	7193.84	8.383	1.60	1015	7699.66	8.477	1.52	1075	8210.92	8.564	1.37
956	7202.23	8.385	1.60	1016	7708.14	8.478	1.52	1076	8219.48	8.565	1.37
957	7210.61	8.386	1.60	1017	7716.62	8.480	1.51	1077	8228.05	8.566	1.36
958	7219.00	8.388	1.60	1018	7725.10	8.481	1.51	1078	8236.62	8.568	1.36
959	7227.39	8.389	1.60	1019	7733.58	8.483	1.51	1079	8245.19	8.569	1.36
960	7235.78	8.391	1.60	1020	7742.06	8.484	1.51	1080	8253.76	8.571	1.35

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1080	8253.76	8.571	1.35	1140	8770.30	8.645	1.12	1200	9290.86	8.704	0.81
1081	8262.33	8.572	1.35	1141	8778.94	8.646	1.12	1201	9299.56	8.704	0.80
1082	8270.90	8.573	1.35	1142	8787.59	8.647	1.11	1202	9308.27	8.705	0.80
1083	8279.47	8.575	1.34	1143	8796.24	8.649	1.11	1203	9316.98	8.706	0.79
1084	8288.05	8.576	1.34	1144	8804.89	8.650	1.11	1204	9325.68	8.707	0.79
1085	8296.63	8.577	1.34	1145	8813.54	8.651	1.10	1205	9334.39	8.708	0.78
1086	8305.20	8.579	1.33	1146	8822.19	8.652	1.10	1206	9343.10	8.708	0.77
1087	8313.78	8.580	1.33	1147	8830.84	8.653	1.09	1207	9351.81	8.709	0.77
1088	8322.36	8.581	1.33	1148	8839.50	8.654	1.09	1208	9360.52	8.710	0.76
1089	8330.95	8.583	1.32	1149	8848.15	8.655	1.08	1209	9369.23	8.711	0.76
1090	8339.53	8.584	1.32	1150	8856.81	8.656	1.08	1210	9377.94	8.711	0.75
1091	8348.11	8.585	1.32	1151	8865.46	8.657	1.07	1211	9386.65	8.712	0.74
1092	8356.70	8.587	1.31	1152	8874.12	8.658	1.07	1212	9395.36	8.713	0.74
1093	8365.29	8.588	1.31	1153	8882.78	8.659	1.06	1213	9404.08	8.714	0.73
1094	8373.88	8.589	1.31	1154	8891.44	8.661	1.06	1214	9412.79	8.714	0.72
1095	8382.46	8.590	1.30	1155	8900.10	8.662	1.05	1215	9421.50	8.715	0.72
1096	8391.06	8.592	1.30	1156	8908.76	8.663	1.05	1216	9430.22	8.716	0.71
1097	8399.65	8.593	1.30	1157	8917.43	8.664	1.04	1217	9438.94	8.717	0.71
1098	8408.24	8.594	1.29	1158	8926.09	8.665	1.04	1218	9447.65	8.717	0.70
1099	8416.84	8.596	1.29	1159	8934.76	8.666	1.03	1219	9456.37	8.718	0.69
1100	8425.43	8.597	1.29	1160	8943.42	8.667	1.03	1220	9465.09	8.719	0.69
1101	8434.03	8.598	1.28	1161	8952.09	8.668	1.02	1221	9473.81	8.719	0.68
1102	8442.63	8.600	1.28	1162	8960.76	8.669	1.02	1222	9482.53	8.720	0.67
1103	8451.23	8.601	1.27	1163	8969.43	8.670	1.01	1223	9491.25	8.721	0.67
1104	8459.83	8.602	1.27	1164	8978.10	8.671	1.01	1224	9499.97	8.721	0.66
1105	8468.43	8.603	1.27	1165	8986.77	8.672	1.00	1225	9508.69	8.722	0.65
1106	8477.04	8.605	1.26	1166	8995.44	8.673	1.00	1226	9517.41	8.723	0.65
1107	8485.64	8.606	1.26	1167	9004.11	8.674	0.99	1227	9526.14	8.723	0.64
1108	8494.25	8.607	1.26	1168	9012.79	8.675	0.99	1228	9534.86	8.724	0.63
1109	8502.86	8.608	1.25	1169	9021.46	8.676	0.98	1229	9543.58	8.725	0.63
1110	8511.47	8.610	1.25	1170	9030.14	8.677	0.98	1230	9552.31	8.725	0.62
1111	8520.08	8.611	1.24	1171	9038.82	8.678	0.97	1231	9561.03	8.726	0.61
1112	8528.69	8.612	1.24	1172	9047.50	8.679	0.97	1232	9569.76	8.726	0.61
1113	8537.30	8.613	1.24	1173	9056.18	8.680	0.96	1233	9578.49	8.727	0.60
1114	8545.92	8.615	1.23	1174	9064.86	8.681	0.96	1234	9587.21	8.728	0.59
1115	8554.53	8.616	1.23	1175	9073.54	8.682	0.95	1235	9595.94	8.728	0.59
1116	8563.15	8.617	1.22	1176	9082.22	8.683	0.95	1236	9604.67	8.729	0.58
1117	8571.76	8.618	1.22	1177	9090.90	8.684	0.94	1237	9613.40	8.729	0.57
1118	8580.38	8.619	1.22	1178	9099.59	8.684	0.94	1238	9622.13	8.730	0.57
1119	8589.00	8.621	1.21	1179	9108.27	8.685	0.93	1239	9630.86	8.731	0.56
1120	8597.62	8.622	1.21	1180	9116.96	8.686	0.92	1240	9639.59	8.731	0.55
1121	8606.25	8.623	1.20	1181	9125.64	8.687	0.92	1241	9648.32	8.732	0.55
1122	8614.87	8.624	1.20	1182	9134.33	8.688	0.91	1242	9657.05	8.732	0.54
1123	8623.50	8.626	1.20	1183	9143.02	8.689	0.91	1243	9665.79	8.733	0.53
1124	8632.12	8.627	1.19	1184	9151.71	8.690	0.90	1244	9674.52	8.733	0.52
1125	8640.75	8.628	1.19	1185	9160.40	8.691	0.90	1245	9683.25	8.734	0.52
1126	8649.38	8.629	1.18	1186	9169.09	8.692	0.89	1246	9691.99	8.734	0.51
1127	8658.01	8.630	1.18	1187	9177.78	8.693	0.89	1247	9700.72	8.735	0.50
1128	8666.64	8.631	1.18	1188	9186.48	8.694	0.88	1248	9709.46	8.735	0.50
1129	8675.27	8.633	1.17	1189	9195.17	8.694	0.87	1249	9718.19	8.736	0.49
1130	8683.90	8.634	1.17	1190	9203.87	8.695	0.87	1250	9726.93	8.736	0.48
1131	8692.54	8.635	1.16	1191	9212.56	8.696	0.86	1251	9735.66	8.737	0.47
1132	8701.17	8.636	1.16	1192	9221.26	8.697	0.86	1252	9744.40	8.737	0.47
1133	8709.81	8.637	1.15	1193	9229.96	8.698	0.85	1253	9753.14	8.738	0.46
1134	8718.45	8.638	1.15	1194	9238.65	8.699	0.85	1254	9761.88	8.738	0.45
1135	8727.09	8.640	1.15	1195	9247.35	8.700	0.84	1255	9770.62	8.739	0.45
1136	8735.73	8.641	1.14	1196	9256.05	8.700	0.83	1256	9779.35	8.739	0.44
1137	8744.37	8.642	1.14	1197	9264.75	8.701	0.83	1257	9788.09	8.739	0.43
1138	8753.01	8.643	1.13	1198	9273.46	8.702	0.82	1258	9796.83	8.740	0.42
1139	8761.65	8.644	1.13	1199	9282.16	8.703	0.82	1259	9805.57	8.740	0.42
1140	8770.30	8.645	1.12	1200	9290.86	8.704	0.81	1260	9814.31	8.741	0.41

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1260	9814.31	8.741	0.41	1320	10339.21	8.751	-0.08	1380	10863.77	8.729	-0.66
1261	9823.05	8.741	0.40	1321	10347.96	8.751	-0.09	1381	10872.50	8.728	-0.67
1262	9831.80	8.742	0.39	1322	10356.71	8.751	-0.10	1382	10881.23	8.728	-0.68
1263	9840.54	8.742	0.39	1323	10365.46	8.751	-0.11	1383	10889.96	8.727	-0.69
1264	9849.28	8.742	0.38	1324	10374.21	8.750	-0.12	1384	10898.68	8.726	-0.70
1265	9858.02	8.743	0.37	1325	10382.96	8.750	-0.13	1385	10907.41	8.725	-0.71
1266	9866.76	8.743	0.36	1326	10391.71	8.750	-0.14	1386	10916.14	8.725	-0.72
1267	9875.51	8.743	0.36	1327	10400.46	8.750	-0.15	1387	10924.86	8.724	-0.73
1268	9884.25	8.744	0.35	1328	10409.21	8.750	-0.16	1388	10933.58	8.723	-0.74
1269	9893.00	8.744	0.34	1329	10417.96	8.750	-0.17	1389	10942.31	8.723	-0.75
1270	9901.74	8.744	0.33	1330	10426.71	8.750	-0.18	1390	10951.03	8.722	-0.76
1271	9910.48	8.745	0.32	1331	10435.46	8.749	-0.18	1391	10959.75	8.721	-0.77
1272	9919.23	8.745	0.32	1332	10444.21	8.749	-0.19	1392	10968.47	8.720	-0.78
1273	9927.97	8.745	0.31	1333	10452.96	8.749	-0.20	1393	10977.19	8.719	-0.79
1274	9936.72	8.746	0.30	1334	10461.71	8.749	-0.21	1394	10985.91	8.719	-0.80
1275	9945.47	8.746	0.29	1335	10470.46	8.749	-0.22	1395	10994.63	8.718	-0.81
1276	9954.21	8.746	0.29	1336	10479.21	8.748	-0.23	1396	11003.35	8.717	-0.82
1277	9962.96	8.747	0.28	1337	10487.95	8.748	-0.24	1397	11012.06	8.716	-0.84
1278	9971.71	8.747	0.27	1338	10496.70	8.748	-0.25	1398	11020.78	8.715	-0.85
1279	9980.45	8.747	0.26	1339	10505.45	8.748	-0.26	1399	11029.49	8.715	-0.86
1280	9989.20	8.747	0.25	1340	10514.20	8.747	-0.27	1400	11038.21	8.714	-0.87
1281	9997.95	8.748	0.25	1341	10522.94	8.747	-0.28	1401	11046.92	8.713	-0.88
1282	10006.69	8.748	0.24	1342	10531.69	8.747	-0.29	1402	11055.63	8.712	-0.89
1283	10015.44	8.748	0.23	1343	10540.44	8.747	-0.30	1403	11064.34	8.711	-0.90
1284	10024.19	8.748	0.22	1344	10549.18	8.746	-0.31	1404	11073.05	8.710	-0.91
1285	10032.94	8.749	0.21	1345	10557.93	8.746	-0.32	1405	11081.76	8.709	-0.92
1286	10041.69	8.749	0.21	1346	10566.68	8.746	-0.32	1406	11090.47	8.708	-0.93
1287	10050.44	8.749	0.20	1347	10575.42	8.745	-0.33	1407	11099.18	8.707	-0.94
1288	10059.19	8.749	0.19	1348	10584.17	8.745	-0.34	1408	11107.89	8.706	-0.95
1289	10067.93	8.749	0.18	1349	10592.91	8.745	-0.35	1409	11116.59	8.705	-0.96
1290	10076.68	8.749	0.17	1350	10601.66	8.744	-0.36	1410	11125.30	8.704	-0.97
1291	10085.43	8.750	0.16	1351	10610.40	8.744	-0.37	1411	11134.00	8.703	-0.98
1292	10094.18	8.750	0.16	1352	10619.14	8.743	-0.38	1412	11142.71	8.703	-0.99
1293	10102.93	8.750	0.15	1353	10627.89	8.743	-0.39	1413	11151.41	8.702	-1.00
1294	10111.68	8.750	0.14	1354	10636.63	8.743	-0.40	1414	11160.11	8.700	-1.01
1295	10120.43	8.750	0.13	1355	10645.37	8.742	-0.41	1415	11168.81	8.699	-1.03
1296	10129.18	8.750	0.12	1356	10654.11	8.742	-0.42	1416	11177.51	8.698	-1.04
1297	10137.93	8.750	0.11	1357	10662.86	8.741	-0.43	1417	11186.21	8.697	-1.05
1298	10146.68	8.751	0.11	1358	10671.60	8.741	-0.44	1418	11194.90	8.696	-1.06
1299	10155.44	8.751	0.10	1359	10680.34	8.741	-0.45	1419	11203.60	8.695	-1.07
1300	10164.19	8.751	0.09	1360	10689.08	8.740	-0.46	1420	11212.29	8.694	-1.08
1301	10172.94	8.751	0.08	1361	10697.82	8.740	-0.47	1421	11220.99	8.693	-1.09
1302	10181.69	8.751	0.07	1362	10706.56	8.739	-0.48	1422	11229.68	8.692	-1.10
1303	10190.44	8.751	0.06	1363	10715.30	8.739	-0.49	1423	11238.37	8.691	-1.11
1304	10199.19	8.751	0.06	1364	10724.03	8.738	-0.50	1424	11247.06	8.690	-1.12
1305	10207.94	8.751	0.05	1365	10732.77	8.738	-0.51	1425	11255.75	8.689	-1.13
1306	10216.69	8.751	0.04	1366	10741.51	8.737	-0.52	1426	11264.44	8.688	-1.14
1307	10225.44	8.751	0.03	1367	10750.25	8.737	-0.53	1427	11273.13	8.686	-1.15
1308	10234.19	8.751	0.02	1368	10758.98	8.736	-0.54	1428	11281.81	8.685	-1.17
1309	10242.95	8.751	0.01	1369	10767.72	8.736	-0.55	1429	11290.50	8.684	-1.18
1310	10251.70	8.751	0.00	1370	10776.45	8.735	-0.56	1430	11299.18	8.683	-1.19
1311	10260.45	8.751	-0.01	1371	10785.19	8.734	-0.57	1431	11307.86	8.682	-1.20
1312	10269.20	8.751	-0.01	1372	10793.92	8.734	-0.58	1432	11316.54	8.680	-1.21
1313	10277.95	8.751	-0.02	1373	10802.66	8.733	-0.59	1433	11325.22	8.679	-1.22
1314	10286.70	8.751	-0.03	1374	10811.39	8.733	-0.60	1434	11333.90	8.678	-1.23
1315	10295.45	8.751	-0.04	1375	10820.12	8.732	-0.61	1435	11342.58	8.677	-1.24
1316	10304.20	8.751	-0.05	1376	10828.85	8.731	-0.62	1436	11351.25	8.676	-1.25
1317	10312.96	8.751	-0.06	1377	10837.58	8.731	-0.63	1437	11359.93	8.674	-1.26
1318	10321.71	8.751	-0.07	1378	10846.32	8.730	-0.64	1438	11368.60	8.673	-1.27
1319	10330.46	8.751	-0.08	1379	10855.05	8.730	-0.65	1439	11377.28	8.672	-1.28
1320	10339.21	8.751	-0.08	1380	10863.77	8.729	-0.66	1440	11385.95	8.670	-1.30

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1440	11385.95	8.670	-1.30	1500	11903.45	8.573	-1.95	1560	12413.94	8.437	-2.56
1441	11394.62	8.669	-1.31	1501	11912.02	8.571	-1.96	1561	12422.38	8.435	-2.57
1442	11403.29	8.668	-1.32	1502	11920.59	8.569	-1.97	1562	12430.81	8.432	-2.58
1443	11411.95	8.667	-1.33	1503	11929.16	8.567	-1.98	1563	12439.24	8.430	-2.59
1444	11420.62	8.665	-1.34	1504	11937.72	8.565	-1.99	1564	12447.67	8.427	-2.60
1445	11429.28	8.664	-1.35	1505	11946.29	8.563	-2.00	1565	12456.09	8.424	-2.61
1446	11437.95	8.663	-1.36	1506	11954.85	8.561	-2.02	1566	12464.52	8.422	-2.61
1447	11446.61	8.661	-1.37	1507	11963.41	8.559	-2.03	1567	12472.94	8.419	-2.62
1448	11455.27	8.660	-1.38	1508	11971.97	8.557	-2.04	1568	12481.35	8.416	-2.63
1449	11463.93	8.658	-1.39	1509	11980.53	8.555	-2.05	1569	12489.77	8.414	-2.64
1450	11472.58	8.657	-1.40	1510	11989.08	8.553	-2.06	1570	12498.18	8.411	-2.65
1451	11481.24	8.656	-1.42	1511	11997.63	8.551	-2.07	1571	12506.59	8.409	-2.66
1452	11489.90	8.654	-1.43	1512	12006.18	8.549	-2.08	1572	12515.00	8.406	-2.67
1453	11498.55	8.653	-1.44	1513	12014.73	8.547	-2.09	1573	12523.40	8.403	-2.68
1454	11507.20	8.651	-1.45	1514	12023.27	8.545	-2.10	1574	12531.81	8.401	-2.68
1455	11515.85	8.650	-1.46	1515	12031.82	8.543	-2.11	1575	12540.21	8.398	-2.69
1456	11524.50	8.648	-1.47	1516	12040.36	8.540	-2.12	1576	12548.60	8.395	-2.70
1457	11533.15	8.647	-1.48	1517	12048.90	8.538	-2.13	1577	12557.00	8.392	-2.71
1458	11541.79	8.645	-1.49	1518	12057.44	8.536	-2.14	1578	12565.39	8.390	-2.72
1459	11550.44	8.644	-1.50	1519	12065.97	8.534	-2.15	1579	12573.77	8.387	-2.73
1460	11559.08	8.642	-1.51	1520	12074.50	8.532	-2.16	1580	12582.16	8.384	-2.74
1461	11567.72	8.641	-1.53	1521	12083.04	8.530	-2.17	1581	12590.54	8.382	-2.74
1462	11576.36	8.639	-1.54	1522	12091.56	8.528	-2.18	1582	12598.92	8.379	-2.75
1463	11585.00	8.638	-1.55	1523	12100.09	8.525	-2.19	1583	12607.30	8.376	-2.76
1464	11593.64	8.636	-1.56	1524	12108.61	8.523	-2.21	1584	12615.68	8.373	-2.77
1465	11602.28	8.635	-1.57	1525	12117.14	8.521	-2.22	1585	12624.05	8.370	-2.78
1466	11610.91	8.633	-1.58	1526	12125.66	8.519	-2.23	1586	12632.42	8.368	-2.78
1467	11619.54	8.631	-1.59	1527	12134.17	8.516	-2.24	1587	12640.78	8.365	-2.79
1468	11628.17	8.630	-1.60	1528	12142.69	8.514	-2.25	1588	12649.15	8.362	-2.80
1469	11636.80	8.628	-1.61	1529	12151.20	8.512	-2.26	1589	12657.51	8.359	-2.81
1470	11645.43	8.627	-1.62	1530	12159.71	8.510	-2.27	1590	12665.86	8.356	-2.82
1471	11654.05	8.625	-1.64	1531	12168.22	8.507	-2.28	1591	12674.22	8.354	-2.82
1472	11662.68	8.623	-1.65	1532	12176.73	8.505	-2.29	1592	12682.57	8.351	-2.83
1473	11671.30	8.622	-1.66	1533	12185.23	8.503	-2.30	1593	12690.92	8.348	-2.84
1474	11679.92	8.620	-1.67	1534	12193.73	8.501	-2.31	1594	12699.27	8.345	-2.85
1475	11688.54	8.618	-1.68	1535	12202.23	8.498	-2.32	1595	12707.61	8.342	-2.85
1476	11697.16	8.617	-1.69	1536	12210.73	8.496	-2.33	1596	12715.95	8.339	-2.86
1477	11705.77	8.615	-1.70	1537	12219.23	8.494	-2.34	1597	12724.29	8.337	-2.87
1478	11714.39	8.613	-1.71	1538	12227.72	8.491	-2.35	1598	12732.63	8.334	-2.88
1479	11723.00	8.612	-1.72	1539	12236.21	8.489	-2.36	1599	12740.96	8.331	-2.88
1480	11731.61	8.610	-1.73	1540	12244.70	8.487	-2.37	1600	12749.29	8.328	-2.89
1481	11740.22	8.608	-1.74	1541	12253.18	8.484	-2.38	1601	12757.61	8.325	-2.90
1482	11748.83	8.606	-1.76	1542	12261.66	8.482	-2.39	1602	12765.94	8.322	-2.91
1483	11757.43	8.605	-1.77	1543	12270.14	8.479	-2.40	1603	12774.26	8.319	-2.91
1484	11766.04	8.603	-1.78	1544	12278.62	8.477	-2.41	1604	12782.58	8.316	-2.92
1485	11774.64	8.601	-1.79	1545	12287.10	8.475	-2.42	1605	12790.89	8.313	-2.93
1486	11783.24	8.599	-1.80	1546	12295.57	8.472	-2.43	1606	12799.20	8.310	-2.93
1487	11791.84	8.597	-1.81	1547	12304.04	8.470	-2.44	1607	12807.51	8.308	-2.94
1488	11800.43	8.596	-1.82	1548	12312.51	8.467	-2.45	1608	12815.82	8.305	-2.95
1489	11809.03	8.594	-1.83	1549	12320.98	8.465	-2.46	1609	12824.12	8.302	-2.95
1490	11817.62	8.592	-1.84	1550	12329.44	8.462	-2.47	1610	12832.42	8.299	-2.96
1491	11826.21	8.590	-1.85	1551	12337.90	8.460	-2.47	1611	12840.72	8.296	-2.97
1492	11834.80	8.588	-1.86	1552	12346.36	8.457	-2.48	1612	12849.01	8.293	-2.97
1493	11843.39	8.586	-1.88	1553	12354.82	8.455	-2.49	1613	12857.30	8.290	-2.98
1494	11851.98	8.585	-1.89	1554	12363.27	8.452	-2.50	1614	12865.59	8.287	-2.98
1495	11860.56	8.583	-1.90	1555	12371.72	8.450	-2.51	1615	12873.88	8.284	-2.99
1496	11869.14	8.581	-1.91	1556	12380.17	8.447	-2.52	1616	12882.16	8.281	-3.00
1497	11877.72	8.579	-1.92	1557	12388.62	8.445	-2.53	1617	12890.44	8.278	-3.00
1498	11886.30	8.577	-1.93	1558	12397.06	8.442	-2.54	1618	12898.72	8.275	-3.01
1499	11894.87	8.575	-1.94	1559	12405.50	8.440	-2.55	1619	12906.99	8.272	-3.01
1500	11903.45	8.573	-1.95	1560	12413.94	8.437	-2.56	1620	12915.26	8.269	-3.02

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1620	12915.26	8.269	-3.02	1680	13405.79	8.081	-3.19	1740	13884.98	7.895	-2.88
1621	12923.53	8.266	-3.03	1681	13413.87	8.077	-3.19	1741	13892.87	7.893	-2.87
1622	12931.79	8.263	-3.03	1682	13421.95	8.074	-3.19	1742	13900.76	7.890	-2.86
1623	12940.05	8.260	-3.04	1683	13430.02	8.071	-3.19	1743	13908.65	7.887	-2.85
1624	12948.31	8.257	-3.04	1684	13438.09	8.068	-3.19	1744	13916.54	7.884	-2.84
1625	12956.57	8.254	-3.05	1685	13446.16	8.065	-3.19	1745	13924.42	7.881	-2.83
1626	12964.82	8.251	-3.05	1686	13454.22	8.061	-3.19	1746	13932.30	7.878	-2.81
1627	12973.07	8.248	-3.06	1687	13462.28	8.058	-3.18	1747	13940.18	7.876	-2.80
1628	12981.31	8.244	-3.06	1688	13470.33	8.055	-3.18	1748	13948.05	7.873	-2.79
1629	12989.56	8.241	-3.07	1689	13478.39	8.052	-3.18	1749	13955.92	7.870	-2.78
1630	12997.80	8.238	-3.07	1690	13486.44	8.049	-3.18	1750	13963.79	7.867	-2.76
1631	13006.03	8.235	-3.08	1691	13494.49	8.046	-3.18	1751	13971.66	7.864	-2.75
1632	13014.27	8.232	-3.08	1692	13502.53	8.042	-3.18	1752	13979.52	7.862	-2.74
1633	13022.50	8.229	-3.09	1693	13510.57	8.039	-3.17	1753	13987.38	7.859	-2.73
1634	13030.72	8.226	-3.09	1694	13518.61	8.036	-3.17	1754	13995.24	7.856	-2.71
1635	13038.95	8.223	-3.10	1695	13526.64	8.033	-3.17	1755	14003.09	7.854	-2.70
1636	13047.17	8.220	-3.10	1696	13534.67	8.030	-3.17	1756	14010.94	7.851	-2.69
1637	13055.39	8.217	-3.11	1697	13542.70	8.026	-3.16	1757	14018.79	7.848	-2.67
1638	13063.60	8.214	-3.11	1698	13550.73	8.023	-3.16	1758	14026.64	7.845	-2.66
1639	13071.82	8.210	-3.11	1699	13558.75	8.020	-3.16	1759	14034.48	7.843	-2.64
1640	13080.02	8.207	-3.12	1700	13566.77	8.017	-3.15	1760	14042.33	7.840	-2.63
1641	13088.23	8.204	-3.12	1701	13574.78	8.014	-3.15	1761	14050.17	7.838	-2.61
1642	13096.43	8.201	-3.13	1702	13582.79	8.011	-3.15	1762	14058.00	7.835	-2.60
1643	13104.63	8.198	-3.13	1703	13590.80	8.008	-3.14	1763	14065.84	7.832	-2.58
1644	13112.83	8.195	-3.13	1704	13598.81	8.004	-3.14	1764	14073.67	7.830	-2.57
1645	13121.02	8.192	-3.14	1705	13606.81	8.001	-3.13	1765	14081.49	7.827	-2.55
1646	13129.21	8.189	-3.14	1706	13614.81	7.998	-3.13	1766	14089.32	7.825	-2.53
1647	13137.40	8.185	-3.14	1707	13622.81	7.995	-3.12	1767	14097.14	7.822	-2.52
1648	13145.58	8.182	-3.15	1708	13630.80	7.992	-3.12	1768	14104.97	7.820	-2.50
1649	13153.76	8.179	-3.15	1709	13638.79	7.989	-3.12	1769	14112.78	7.817	-2.48
1650	13161.94	8.176	-3.15	1710	13646.78	7.986	-3.11	1770	14120.60	7.815	-2.47
1651	13170.12	8.173	-3.16	1711	13654.76	7.983	-3.11	1771	14128.41	7.812	-2.45
1652	13178.29	8.170	-3.16	1712	13662.74	7.979	-3.10	1772	14136.22	7.810	-2.43
1653	13186.45	8.167	-3.16	1713	13670.72	7.976	-3.09	1773	14144.03	7.807	-2.41
1654	13194.62	8.163	-3.16	1714	13678.70	7.973	-3.09	1774	14151.84	7.805	-2.40
1655	13202.78	8.160	-3.17	1715	13686.67	7.970	-3.08	1775	14159.64	7.803	-2.38
1656	13210.94	8.157	-3.17	1716	13694.64	7.967	-3.08	1776	14167.44	7.800	-2.36
1657	13219.10	8.154	-3.17	1717	13702.60	7.964	-3.07	1777	14175.24	7.798	-2.34
1658	13227.25	8.151	-3.17	1718	13710.57	7.961	-3.07	1778	14183.04	7.796	-2.32
1659	13235.40	8.148	-3.18	1719	13718.53	7.958	-3.06	1779	14190.83	7.793	-2.30
1660	13243.54	8.144	-3.18	1720	13726.48	7.955	-3.05	1780	14198.63	7.791	-2.28
1661	13251.69	8.141	-3.18	1721	13734.44	7.952	-3.05	1781	14206.42	7.789	-2.26
1662	13259.83	8.138	-3.18	1722	13742.39	7.949	-3.04	1782	14214.20	7.786	-2.24
1663	13267.96	8.135	-3.18	1723	13750.33	7.946	-3.03	1783	14221.99	7.784	-2.22
1664	13276.09	8.132	-3.18	1724	13758.28	7.943	-3.02	1784	14229.77	7.782	-2.20
1665	13284.22	8.128	-3.19	1725	13766.22	7.940	-3.02	1785	14237.55	7.780	-2.18
1666	13292.35	8.125	-3.19	1726	13774.16	7.937	-3.01	1786	14245.33	7.778	-2.16
1667	13300.48	8.122	-3.19	1727	13782.09	7.934	-3.00	1787	14253.11	7.775	-2.14
1668	13308.60	8.119	-3.19	1728	13790.02	7.931	-2.99	1788	14260.88	7.773	-2.12
1669	13316.71	8.116	-3.19	1729	13797.95	7.928	-2.98	1789	14268.65	7.771	-2.09
1670	13324.83	8.112	-3.19	1730	13805.88	7.925	-2.98	1790	14276.42	7.769	-2.07
1671	13332.94	8.109	-3.19	1731	13813.80	7.922	-2.97	1791	14284.19	7.767	-2.05
1672	13341.05	8.106	-3.19	1732	13821.72	7.919	-2.96	1792	14291.96	7.765	-2.03
1673	13349.15	8.103	-3.19	1733	13829.64	7.916	-2.95	1793	14299.72	7.763	-2.00
1674	13357.25	8.100	-3.19	1734	13837.55	7.913	-2.94	1794	14307.48	7.761	-1.98
1675	13365.35	8.097	-3.19	1735	13845.47	7.910	-2.93	1795	14315.24	7.759	-1.96
1676	13373.44	8.093	-3.19	1736	13853.37	7.907	-2.92	1796	14323.00	7.757	-1.93
1677	13381.54	8.090	-3.19	1737	13861.28	7.904	-2.91	1797	14330.76	7.755	-1.91
1678	13389.62	8.087	-3.19	1738	13869.18	7.901	-2.90	1798	14338.51	7.753	-1.88
1679	13397.71	8.084	-3.19	1739	13877.08	7.898	-2.89	1799	14346.27	7.751	-1.86
1680	13405.79	8.081	-3.19	1740	13884.98	7.895	-2.88	1800	14354.02	7.750	-1.83

TABLE 4.5.2. *Type BN thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1800	14354.02	7.750	-1.83	1810	14431.42	7.733	-1.57	1820	14508.68	7.718	-1.27
1801	14361.76	7.748	-1.81	1811	14439.16	7.731	-1.54				
1802	14369.51	7.746	-1.78	1812	14446.89	7.729	-1.51				
1803	14377.26	7.744	-1.76	1813	14454.62	7.728	-1.48				
1804	14385.00	7.742	-1.73	1814	14462.34	7.727	-1.45				
1805	14392.74	7.741	-1.70	1815	14470.07	7.725	-1.42				
1806	14400.48	7.739	-1.68	1816	14477.79	7.724	-1.39				
1807	14408.22	7.737	-1.65	1817	14485.52	7.722	-1.36				
1808	14415.96	7.736	-1.62	1818	14493.24	7.721	-1.33				
1809	14423.69	7.734	-1.59	1819	14500.96	7.720	-1.30				
1810	14431.42	7.733	-1.57	1820	14508.68	7.718	-1.27				

TABLE 4.5.3. Thermoelectric values at the fixed points for Type BN thermoelements versus platinum, Pt-67

Fixed point	Temp. °C	E μV	S $\mu\text{V}/^\circ\text{C}$	dS/dT $\text{nV}/^\circ\text{C}$
Ice point	0.000	0.00	5.066	19.58
Ether TP	26.870	142.80	5.548	16.38
Water BP	100.000	585.84	6.488	9.80
Benzoic TP	122.370	733.30	6.690	8.31
Indium FP	156.634	967.03	6.941	6.41
Tin FP	231.9681	1505.03	7.306	3.54
Bismuth FP	271.442	1795.90	7.426	2.59
Cadmium FP	321.108	2167.53	7.533	1.79
Lead FP	327.502	2215.73	7.544	1.71
Mercury BP	356.660	2436.38	7.589	1.42
Zinc FP	419.580	2916.45	7.667	1.08
Sulphur BP	444.674	3109.17	7.693	1.02
Cu-Al FP	548.23	3911.23	7.798	1.06
Antimony FP	630.74	4558.46	7.893	1.24
Aluminum FP	660.37	4792.87	7.931	1.31
Silver FP	961.93	7251.97	8.394	1.60
Gold FP	1064.43	8120.48	8.549	1.40
Copper FP	1084.5	8292.34	8.577	1.34
Nickel FP	1455	11515.85	8.650	-1.46
Cobalt FP	1494	11851.98	8.585	-1.89
Palladium FP	1554	12363.27	8.452	-2.50
Platinum FP	1772	14136.22	7.810	-2.43

TABLE 4.5.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type BN thermoelements versus platinum, Pt-67

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
0 to 200 °C	8	0.3	<0.1	<0.01	<0.01	<0.01
200 to 400 °C	8	0.6	0.1	<0.01	<0.01	<0.01
400 to 600 °C	8	0.9	0.1	<0.01	<0.01	<0.01
600 to 800 °C	8	2	0.1	<0.01	<0.01	<0.01
800 to 1000 °C	8	4	0.5	<0.01	<0.01	<0.01
1000 to 1200 °C	8	9	2	0.02	<0.01	<0.01
1200 to 1400 °C	8	20	4	0.03	<0.01	<0.01
1400 to 1600 °C	8	50	7	0.07	<0.01	<0.01
1600 to 1820 °C	8	100	14	0.2	0.02	<0.01

5. TYPE E—*Nickel–Chromium Alloy Versus Copper–Nickel Alloy Thermocouples*

5.1. Material Specifications and Precautions

This type, and the other base-metal types, do *not* have specific chemical compositions given in standards; rather, any material that fits the specified table within certain limits (see the end of this section) can be considered to be a Type E thermocouple. The positive thermoelement, EP, is the same material as KP. The negative thermoelement, EN, is the same material as TN. Their nominal chemical compositions are given in chapters 7 and 8, respectively.

The Type E thermocouple, as a combination of two specific thermoelements, does not have a well-documented history. The first officially recognized reference tables that we are aware of were those calculated by Shenker et al. [1955] in NBS Circular 561. They based their tables upon a combination of data for KP versus platinum and platinum versus TN, where the primary data were taken from earlier NBS Research Papers.

Extensive research on the subzero properties of Type E thermocouples has been carried out by members of the Cryogenics Division in Boulder. That research has been summarized and tabulated by Sparks et al. [1972] in NBS Monograph 124. They showed that Type E thermocouples are very useful down to about liquid hydrogen temperatures (n.b.p. 20.28 K) where their Seebeck coefficient is about $8\ \mu\text{V}/^\circ\text{C}$. They may even be used down to liquid helium temperatures (4.2 K) though their Seebeck coefficient becomes quite low at 4 K, only about $2\ \mu\text{V}/^\circ\text{C}$. Both thermoelements of Type E thermocouples have a relatively low thermal conductivity, good resistance to corrosion in moist atmospheres, and reasonably good homogeneity. Because of these three reasons, and their relatively high Seebeck coefficients, Type E thermocouples have been recommended by Sparks et al. [1972] to be the most useful of the commercially standardized thermocouple combinations for subzero temperature measurements.

For operation below 20 K the nonstandardized combination KP versus *gold–0.07 at% iron* is recommended. The properties of this combination have been described by Sparks et al. [1972a].

Type E thermocouples also have the largest Seebeck coefficient above $0\ ^\circ\text{C}$ of any of the standardized thermocouples. For that reason they are being used more often whenever environmental conditions permit.

Type E thermocouples are recommended by the ASTM Manual [1970] for use in the temperature range from -250 to $871\ ^\circ\text{C}$ in oxidizing or inert atmospheres. The negative thermoelement is subject to deterioration above about $871\ ^\circ\text{C}$, but the thermocouple may be used up to $1000\ ^\circ\text{C}$ for short periods. The ASTM Manual [1970] indicates the following restrictions on the use of Type E thermocouples at high temperatures:

They should not be used in sulfurous, reducing, or alternately reducing and oxidizing atmospheres

unless suitably protected with protecting tubes. They should not be used in vacuum (at high temperatures) for extended times because the chromium in the positive thermoelement vaporizes out of solution and alters the calibration. They should also not be used in atmospheres that promote "green-rot" corrosion (those with low, but not negligible, oxygen content).

The negative thermoelement, a copper-nickel alloy, is subject to composition changes under thermal neutron irradiation since the copper is converted to nickel and zinc.

Neither thermoelement of Type E thermocouples is very sensitive to minor changes in composition or impurity level because both are already heavily alloyed. Similarly they are also not extremely sensitive to minor differences in heat treatment (provided that the treatment does not violate any of the restrictions mentioned above). For most general applications they may be used with the heat treatment given by the wire manufacturers. However, when the highest accuracy is sought, additional preparatory heat treatments may be desirable in order to enhance their performance. Details on this and other phases of the use and behavior of Type KP thermoelements (EP is the same as KP) are given in publications by Potts and McElroy [1962], and N. A. Burley [1969 and 1972].

ASTM Standard E230–72 in the Annual Book of ASTM Standards [1972] specifies that the standard limits of error for Type E commercial thermocouples be $\pm 1.7\ ^\circ\text{C}$ between 0 and $316\ ^\circ\text{C}$ and $\pm \frac{1}{2}$ percent between 316 and $871\ ^\circ\text{C}$. Limits of error are not specified for Type E thermocouples below $0\ ^\circ\text{C}$. Type E thermocouples can also be supplied to meet special limits of error, which are less than the standard limits of error given above: $\pm 1\frac{1}{4}\ ^\circ\text{C}$ between 0 and $316\ ^\circ\text{C}$ and $\pm \frac{3}{8}$ percent between 316 and $871\ ^\circ\text{C}$. The recommended upper temperature limit for protected thermocouples, $871\ ^\circ\text{C}$, applies to AWG 8 (3.3 mm) wire. For smaller wires the recommended upper temperature decreases to $649\ ^\circ\text{C}$ for AWG 14 (1.6 mm), $538\ ^\circ\text{C}$ for AWG 20 (0.8 mm), and $427\ ^\circ\text{C}$ for AWG 24 or 28 (0.5 or 0.3 mm).

5.2 Data Analyses and Comparisons

The fitting functions for Type E thermocouples are based on two sets of data: below $0\ ^\circ\text{C}$, the research and equations of Sparks et al. [1972] were used directly; above $0\ ^\circ\text{C}$, values from NBS Circular 561 [1955] were used after being modified to be on the IPTS–68.

Sparks et al. [1972] based their recommended low temperature values for the positive thermoelement, EP or KP, on a selected wire that was most representative of three calibrated wires selected from nine spools made by three different manufacturers. Similarly, the negative thermoelement, EN or TN, represented the best wire from three calibrated wires taken from ten spools supplied by four different manufac-

turers. The wires for both positive and negative thermoelements were selected after completion of careful spot calibration and inhomogeneity tests as described in Monograph 124. Values for the single thermoelements are given versus platinum, Pt-67. Thermoelectric values for both thermoelements and the combination were relatively difficult to fit precisely. Values for the positive thermoelement required a 12th degree power series to fit 68 points between about -270 and 0°C with an imprecision of $0.12\text{ }\mu\text{V}$; the negative thermoelement required a 13th degree power series to give $0.12\text{ }\mu\text{V}$; and the combination (fit independently), 13th degree for the same imprecision. In Monograph 124 the two thermoelements and the total combination were fit independently; for this Monograph equations for the total combination and for the positive thermoelement were used directly but the equation for the negative thermoelement was obtained by subtraction, symbolically, $EN = E - EP$. Therefore, the equation for TN ($\equiv EN$) given in this Monograph will differ very slightly from the $^{\circ}\text{C}$ transformation of the one given in Monograph 124. The difference in calculated values will usually be less than the imprecision of the fits, $0.12\text{ }\mu\text{V}$.

The data on Type E thermocouples were much more sparse above 0°C than they were below. In particular there were insufficient data on current Type EN material. Data points for Type E were selected from NBS Circular 561, adjusted to the present temperature scale, IPTS-68, and fit with a constrained power series. The power series was constrained to have the same

values for the thermoelectric voltage and Seebeck coefficient at 0°C as those obtained from the low temperature equations. A ninth degree equation (with constrained constant and linear term) fit 21 selected key data points between 0 and 1001°C with an imprecision of $4.4\text{ }\mu\text{V}$. Note that this is about 35 times poorer than the low temperature fit. The second derivative was not constrained at the join.

Fortunately, there was a large amount of good data for the positive thermoelement, EP or KP. The fit was based on 93 data points from three thermoelement calibrations (selected from a set of 13 calibrations) provided by the Temperature Section of the National Bureau of Standards and from a set of selected values in a widely distributed, but unpublished, NBS thermoelement table [Burns, 1967]. All of the high temperature values had to be adjusted to be on the IPTS-68 and to be referenced to Pt-67. A seventh degree equation, with the constant and linear terms constrained to match the low temperature values, had a fitting imprecision of $6.0\text{ }\mu\text{V}$ for a range from 0 to 1371°C .

The tables and graphs for the two thermoelements, EP, and EN, are given in different chapters. Values for EP, identical with KP, are given in chapter 7; for EN, identical with TN, in chapter 8.

The values for the thermoelectric voltages of Type E thermocouples given in this Monograph were compared to those given by Shenker et al. [1955] in NBS Circular 561. The deviations are shown in figure 5.2.1. The values from NBS Circular 561 were ad-

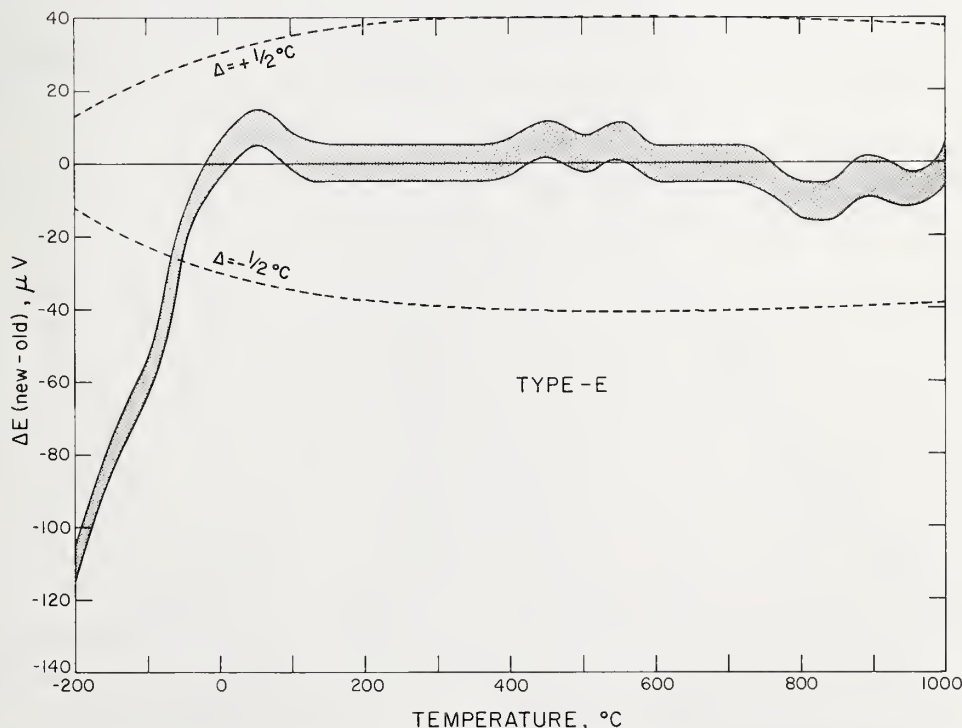


FIGURE 5.2.1. Differences in thermoelectric voltages for Type E thermocouples—comparison of values given in this Monograph to those given in NBS Circular 561.

—The width of the shaded curve indicates the round-off uncertainty in the previous tabular values. Values from the previous publication are adjusted to the IPTS-68. The dashed lines indicate a deviation of $\frac{1}{2}^{\circ}\text{C}$.

justed to the IPTS-68. Above 0 °C, the deviations between the values in this Monograph and those in NBS Circular 561 are caused primarily by the differences in fitting techniques. Below 0 °C, the deviations are caused primarily by chemical composition changes in the thermoelements. Present day materials are slightly different in some of the minor additives. The width of the curve represents the round-off uncertainty (10 μ V) in the tabular values quoted in the previous tables.

5.3. Reference Functions and Tables for Type E Thermocouples

The coefficients for the thirteenth degree expansion for the thermoelectric voltage of Type E thermocouples below 0 °C are given in table 5.3.1. The coefficients for the ninth degree expansion above 0 °C are also given in table 5.3.1. The errors caused by reduced-bit arithmetic for calculating values of the functions are given in table 5.3.4.

The primary reference values for Type E thermocouples are given in table 5.3.2. Values at selected fixed points are given in table 5.3.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient) and second derivative are given in figures 5.3.1, 5.3.2, and 5.3.3, respectively. The irregular dip in the second derivative near 0 °C is a result of the fitting techniques at the join of two regions, it is not a real physical phenomenon.

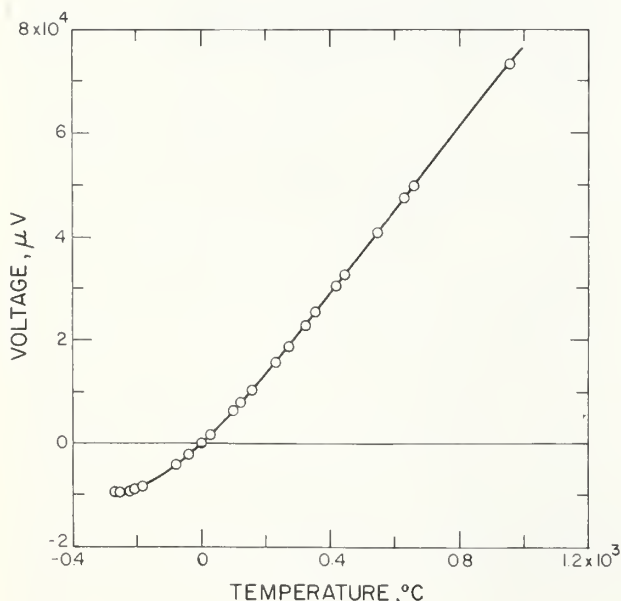


FIGURE 5.3.1. Thermoelectric voltage for Type E thermocouples.

The circles indicate values at various thermometric fixed points on the IPTS-68.

It should be stressed that **Type E thermocouple materials that conform closely to the high temperature tabular values may not necessarily conform closely at low temperatures (below 0 °C) and vice versa.** If Type E thermocouples are to be used for accurate measurements both above and below 0 °C, then the material must be calibrated in the full temperature range, both above and below °C. Special selection of material will usually be required.

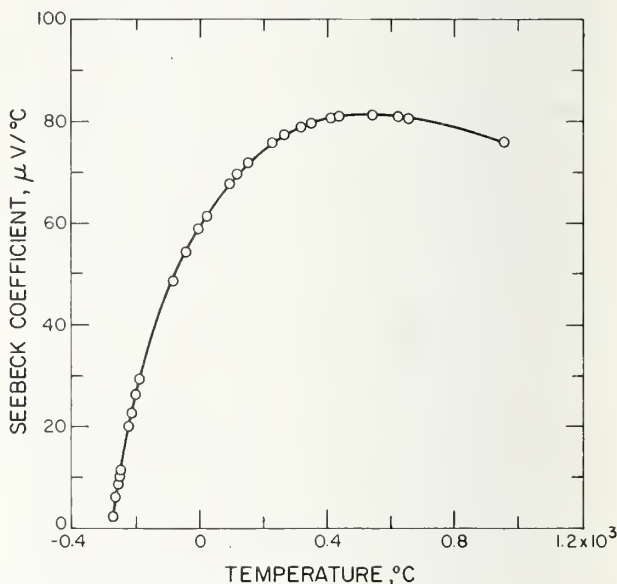


FIGURE 5.3.2. Seebeck coefficient for Type E thermocouples.

The circles indicate values at various thermometric fixed points on the IPTS-68.

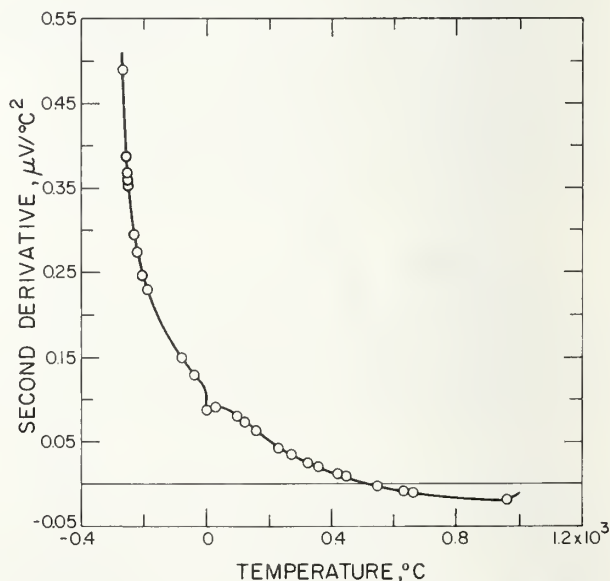


FIGURE 5.3.3. Second derivative of thermoelectric voltage for Type E thermocouples.

The circles indicate values at various thermometric fixed points on the IPTS-68. The irregular dip near 0 °C is a result of the fitting techniques at the join of two regions, it is not a real physical phenomenon.

TABLE 5.3.1. *Power series expansion for the thermoelectric voltage of Type E thermocouples*

Temperature range	Degree	Coefficients	Term
-270 to 0 °C	13	5.8695857799×10^1	T
		$5.1667517705 \times 10^{-2}$	T^2
		$-4.4652683347 \times 10^{-4}$	T^3
		$-1.7346270905 \times 10^{-5}$	T^4
		$-4.8719368427 \times 10^{-7}$	T^5
		$-8.8896550447 \times 10^{-9}$	T^6
		$-1.0930767375 \times 10^{-10}$	T^7
		$-9.1784535039 \times 10^{-13}$	T^8
		$-5.2575158521 \times 10^{-15}$	T^9
		$-2.0169601996 \times 10^{-17}$	T^{10}
		$-4.9502138782 \times 10^{-20}$	T^{11}
		$-7.0177980633 \times 10^{-23}$	T^{12}
		$-4.3671808488 \times 10^{-26}$	T^{13}
0 to 1000 °C	9	5.8695857799×10^1	T
		$4.3110945462 \times 10^{-2}$	T^2
		$5.7220358202 \times 10^{-5}$	T^3
		$-5.4020668085 \times 10^{-7}$	T^4
		$1.5425922111 \times 10^{-9}$	T^5
		$-2.4850089136 \times 10^{-12}$	T^6
		$2.3389721459 \times 10^{-15}$	T^7
		$-1.1946296815 \times 10^{-16}$	T^8
		$2.5561127497 \times 10^{-22}$	T^9

TABLE 5.3.2. *Type E thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-270	-9835.03	1.549	514.24	-240	-9604.15	13.199	346.27	-210	-9062.86	22.507	272.79
-269	-9833.22	2.052	492.52	-239	-9590.78	13.544	344.35	-209	-9040.21	22.779	270.59
-268	-9830.93	2.535	473.56	-238	-9577.06	13.888	342.35	-208	-9017.30	23.048	268.44
-267	-9828.16	3.000	457.05	-237	-9563.00	14.229	340.26	-207	-8994.12	23.316	266.35
-266	-9824.93	3.450	442.72	-236	-9548.61	14.568	338.10	-206	-8970.67	23.581	264.30
-265	-9821.27	3.886	430.32	-235	-9533.87	14.905	335.86	-205	-8946.96	23.844	262.31
-264	-9817.17	4.311	419.62	-234	-9518.80	15.240	333.55	-204	-8922.98	24.106	260.37
-263	-9812.65	4.726	410.41	-233	-9503.39	15.572	331.18	-203	-8898.75	24.365	258.49
-262	-9807.72	5.132	402.52	-232	-9487.65	15.902	328.74	-202	-8874.25	24.623	256.65
-261	-9802.39	5.531	395.77	-231	-9471.59	16.230	326.25	-201	-8849.50	24.878	254.87
-260	-9796.66	5.924	390.00	-230	-9455.19	16.555	323.72	-200	-8824.50	25.132	253.13
-259	-9790.54	6.311	385.07	-229	-9438.48	16.877	321.14	-199	-8799.24	25.385	251.44
-258	-9784.04	6.694	380.87	-228	-9421.44	17.197	318.53	-198	-8773.73	25.635	249.80
-257	-9777.15	7.073	377.27	-227	-9404.09	17.514	315.90	-197	-8747.97	25.884	248.20
-256	-9769.89	7.449	374.19	-226	-9386.41	17.829	313.24	-196	-8721.96	26.132	246.64
-255	-9762.25	7.822	371.52	-225	-9368.43	18.141	310.58	-195	-8695.70	26.378	245.13
-254	-9754.25	8.192	369.20	-224	-9350.13	18.450	307.91	-194	-8669.20	26.622	243.65
-253	-9745.87	8.560	367.15	-223	-9331.53	18.756	305.23	-193	-8642.46	26.865	242.22
-252	-9737.13	8.927	365.31	-222	-9312.62	19.060	302.57	-192	-8615.47	27.106	240.82
-251	-9728.02	9.291	363.63	-221	-9293.41	19.362	299.92	-191	-8588.25	27.347	239.45
-250	-9718.55	9.654	362.06	-220	-9273.90	19.660	297.28	-190	-8560.78	27.585	238.12
-249	-9708.71	10.015	360.56	-219	-9254.09	19.956	294.67	-189	-8533.08	27.823	236.81
-248	-9698.52	10.375	359.10	-218	-9233.99	20.250	292.08	-188	-8505.14	28.059	235.54
-247	-9687.96	10.733	357.65	-217	-9213.59	20.540	289.53	-187	-8476.96	28.294	234.29
-246	-9677.05	11.090	356.19	-216	-9192.91	20.829	287.01	-186	-8448.55	28.528	233.06
-245	-9665.78	11.446	354.69	-215	-9171.94	21.114	284.53	-185	-8419.90	28.760	231.86
-244	-9654.16	11.800	353.15	-214	-9150.68	21.398	282.09	-184	-8391.03	28.991	230.69
-243	-9642.18	12.152	351.54	-213	-9129.14	21.679	279.69	-183	-8361.92	29.221	229.53
-242	-9629.85	12.503	349.86	-212	-9107.32	21.957	277.34	-182	-8332.59	29.450	228.39
-241	-9617.18	12.852	348.11	-211	-9085.23	22.233	275.04	-181	-8303.02	29.678	227.27
-240	-9604.15	13.199	346.27	-210	-9062.86	22.507	272.79	-180	-8273.23	29.905	226.16

TABLE 5.3.2. *Type E thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-180	-8273.23	29.905	226.16	-120	-6106.80	41.797	175.08	-60	-3305.75	51.207	139.22
-179	-8243.21	30.131	225.07	-119	-6064.91	41.972	174.47	-59	-3254.48	51.346	138.70
-178	-8212.97	30.355	223.99	-118	-6022.85	42.146	173.85	-58	-3203.06	51.484	138.19
-177	-8182.50	30.579	222.92	-117	-5980.62	42.319	173.24	-57	-3151.51	51.622	137.69
-176	-8151.81	30.801	221.87	-116	-5938.21	42.492	172.64	-56	-3099.82	51.760	137.18
-175	-8120.90	31.022	220.82	-115	-5895.64	42.665	172.03	-55	-3047.99	51.897	136.68
-174	-8089.77	31.243	219.79	-114	-5852.88	42.836	171.43	-54	-2996.02	52.033	136.19
-173	-8058.42	31.462	218.76	-113	-5809.96	43.008	170.83	-53	-2943.97	52.169	135.69
-172	-8026.85	31.680	217.74	-112	-5766.87	43.178	170.23	-52	-2891.69	52.305	135.20
-171	-7995.06	31.897	216.73	-111	-5723.61	43.348	169.63	-51	-2839.31	52.440	134.71
-170	-7963.05	32.114	215.73	-110	-5680.17	43.517	169.03	-50	-2786.81	52.574	134.22
-169	-7930.83	32.329	214.73	-109	-5636.57	43.686	168.43	-49	-2734.17	52.708	133.73
-168	-7898.39	32.543	213.74	-108	-5592.80	43.854	167.83	-48	-2681.39	52.841	133.24
-167	-7865.74	32.756	212.75	-107	-5548.86	44.022	167.23	-47	-2628.48	52.974	132.76
-166	-7832.88	32.969	211.78	-106	-5504.76	44.189	166.63	-46	-2575.44	53.107	132.27
-165	-7799.81	33.180	210.80	-105	-5460.49	44.355	166.02	-45	-2522.27	53.239	131.79
-164	-7766.52	33.390	209.84	-104	-5416.05	44.521	165.42	-44	-2468.97	53.371	131.30
-163	-7733.03	33.600	208.87	-103	-5371.45	44.686	164.81	-43	-2415.53	53.502	130.82
-162	-7699.32	33.808	207.92	-102	-5326.68	44.850	164.20	-42	-2361.96	53.632	130.33
-161	-7665.41	34.015	206.97	-101	-5281.74	45.014	163.59	-41	-2308.27	53.762	129.85
-160	-7631.29	34.222	206.02	-100	-5236.65	45.178	162.98	-40	-2254.44	53.892	129.37
-159	-7596.97	34.427	205.09	-99	-5191.39	45.340	162.36	-39	-2200.48	54.021	128.89
-158	-7562.44	34.632	204.15	-98	-5145.97	45.502	161.75	-38	-2146.40	54.150	128.41
-157	-7527.70	34.836	203.23	-97	-5100.39	45.664	161.13	-37	-2092.18	54.278	127.94
-156	-7492.77	35.038	202.31	-96	-5054.64	45.825	160.51	-36	-2037.84	54.406	127.46
-155	-7457.63	35.240	201.40	-95	-5008.74	45.985	159.89	-35	-1983.37	54.533	126.99
-154	-7422.29	35.441	200.50	-94	-4962.67	46.144	159.26	-34	-1928.78	54.660	126.53
-153	-7386.75	35.641	199.60	-93	-4916.45	46.303	158.64	-33	-1874.05	54.786	126.06
-152	-7351.00	35.840	198.71	-92	-4870.07	46.462	158.02	-32	-1819.20	54.912	125.61
-151	-7315.06	36.039	197.83	-91	-4823.53	46.619	157.39	-31	-1764.23	55.037	125.16
-150	-7278.93	36.236	196.96	-90	-4776.83	46.776	156.76	-30	-1709.13	55.162	124.71
-149	-7242.59	36.433	196.10	-89	-4729.97	46.933	156.14	-29	-1653.91	55.286	124.28
-148	-7206.06	36.628	195.24	-88	-4682.96	47.089	155.51	-28	-1598.56	55.411	123.85
-147	-7169.34	36.823	194.40	-87	-4635.80	47.244	154.89	-27	-1543.09	55.534	123.43
-146	-7132.42	37.017	193.56	-86	-4588.48	47.398	154.26	-26	-1487.49	55.657	123.03
-145	-7095.30	37.210	192.74	-85	-4541.00	47.552	153.64	-25	-1431.77	55.780	122.63
-144	-7058.00	37.403	191.92	-84	-4493.37	47.706	153.01	-24	-1375.93	55.903	122.24
-143	-7020.50	37.594	191.11	-83	-4445.59	47.858	152.39	-23	-1319.97	56.025	121.86
-142	-6982.81	37.785	190.32	-82	-4397.65	48.010	151.77	-22	-1263.88	56.146	121.49
-141	-6944.93	37.975	189.53	-81	-4349.57	48.162	151.16	-21	-1207.67	56.268	121.13
-140	-6906.86	38.164	188.75	-80	-4301.33	48.313	150.54	-20	-1151.34	56.389	120.78
-139	-6868.60	38.352	187.99	-79	-4252.94	48.463	149.93	-19	-1094.90	56.509	120.43
-138	-6830.15	38.540	187.23	-78	-4204.40	48.613	149.33	-18	-1038.33	56.630	120.09
-137	-6791.52	38.727	186.48	-77	-4155.72	48.762	148.72	-17	-981.64	56.749	119.74
-136	-6752.70	38.913	185.75	-76	-4106.88	48.910	148.12	-16	-924.83	56.869	119.39
-135	-6713.70	39.098	185.02	-75	-4057.90	49.058	147.53	-15	-867.90	56.988	119.03
-134	-6674.50	39.283	184.30	-74	-4008.77	49.205	146.94	-14	-810.85	57.107	118.66
-133	-6635.13	39.467	183.59	-73	-3959.49	49.352	146.35	-13	-753.68	57.226	118.26
-132	-6595.57	39.650	182.89	-72	-3910.06	49.498	145.77	-12	-696.40	57.344	117.82
-131	-6555.83	39.833	182.20	-71	-3860.49	49.643	145.20	-11	-639.00	57.461	117.34
-130	-6515.91	40.014	181.52	-70	-3810.78	49.788	144.63	-10	-581.48	57.578	116.80
-129	-6475.80	40.196	180.85	-69	-3760.92	49.933	144.06	-9	-523.84	57.695	116.19
-128	-6435.52	40.376	180.18	-68	-3710.91	50.076	143.50	-8	-466.09	57.811	115.48
-127	-6395.05	40.556	179.52	-67	-3660.76	50.220	142.95	-7	-408.22	57.926	114.66
-126	-6354.40	40.735	178.87	-66	-3610.47	50.362	142.40	-6	-350.24	58.040	113.71
-125	-6313.58	40.914	178.22	-65	-3560.04	50.504	141.86	-5	-292.14	58.153	112.59
-124	-6272.58	41.092	177.58	-64	-3509.46	50.646	141.32	-4	-233.93	58.265	111.28
-123	-6231.40	41.269	176.95	-63	-3458.75	50.787	140.79	-3	-175.61	58.375	109.74
-122	-6190.04	41.446	176.32	-62	-3407.89	50.928	140.26	-2	-117.18	58.484	107.93
-121	-6148.51	41.622	175.70	-61	-3356.89	51.068	139.74	-1	-58.64	58.591	105.82
-120	-6106.80	41.797	175.08	-60	-3305.75	51.207	139.22	0	0.00	58.696	86.22

TABLE 5.3.2. *Type E thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.0	58.696	86.22	60	3683.4	64.110	89.26	120	7682.9	69.054	74.18
1	58.7	58.782	86.56	61	3747.6	64.199	89.09	121	7752.0	69.128	73.87
2	117.6	58.869	86.88	62	3811.8	64.288	88.93	122	7821.2	69.202	73.57
3	176.5	58.956	87.19	63	3876.1	64.377	88.76	123	7890.4	69.276	73.27
4	235.5	59.043	87.49	64	3940.5	64.465	88.58	124	7959.7	69.349	72.96
5	294.6	59.131	87.78	65	4005.1	64.554	88.40	125	8029.1	69.421	72.66
6	353.7	59.219	88.06	66	4069.7	64.642	88.22	126	8098.6	69.494	72.35
7	413.0	59.307	88.32	67	4134.3	64.730	88.03	127	8168.1	69.566	72.05
8	472.4	59.396	88.57	68	4199.1	64.818	87.84	128	8237.7	69.638	71.74
9	531.8	59.484	88.81	69	4264.0	64.906	87.64	129	8307.4	69.710	71.43
10	591.3	59.573	89.04	70	4328.9	64.993	87.44	130	8377.1	69.781	71.13
11	650.9	59.662	89.25	71	4394.0	65.081	87.24	131	8446.9	69.852	70.82
12	710.6	59.752	89.46	72	4459.1	65.168	87.03	132	8516.8	69.923	70.51
13	770.4	59.841	89.66	73	4524.3	65.255	86.82	133	8586.8	69.993	70.20
14	830.3	59.931	89.84	74	4589.6	65.341	86.60	134	8656.8	70.063	69.90
15	890.3	60.021	90.01	75	4655.0	65.428	86.39	135	8726.9	70.133	69.59
16	950.4	60.111	90.18	76	4720.5	65.514	86.16	136	8797.1	70.202	69.28
17	1010.5	60.201	90.33	77	4786.0	65.600	85.94	137	8867.3	70.271	68.97
18	1070.8	60.292	90.47	78	4851.7	65.686	85.71	138	8937.6	70.340	68.66
19	1131.1	60.382	90.61	79	4917.4	65.772	85.48	139	9008.0	70.409	68.36
20	1191.5	60.473	90.73	80	4983.2	65.857	85.25	140	9078.4	70.477	68.05
21	1252.1	60.564	90.84	81	5049.1	65.942	85.01	141	9148.9	70.545	67.74
22	1312.7	60.655	90.95	82	5115.1	66.027	84.77	142	9219.5	70.612	67.43
23	1373.4	60.746	91.04	83	5181.2	66.112	84.53	143	9290.2	70.680	67.12
24	1434.2	60.837	91.13	84	5247.3	66.196	84.28	144	9360.9	70.747	66.82
25	1495.0	60.928	91.21	85	5313.5	66.280	84.03	145	9431.7	70.813	66.51
26	1556.0	61.019	91.28	86	5379.9	66.364	83.78	146	9502.5	70.880	66.20
27	1617.1	61.110	91.33	87	5446.3	66.448	83.53	147	9573.4	70.946	65.90
28	1678.2	61.202	91.39	88	5512.8	66.531	83.28	148	9644.4	71.011	65.59
29	1739.5	61.293	91.43	89	5579.3	66.614	83.02	149	9715.4	71.077	65.28
30	1800.8	61.385	91.46	90	5646.0	66.697	82.76	150	9786.5	71.142	64.98
31	1862.2	61.476	91.49	91	5712.7	66.780	82.50	151	9857.7	71.207	64.67
32	1923.8	61.568	91.51	92	5779.6	66.862	82.23	152	9929.0	71.271	64.37
33	1985.4	61.659	91.52	93	5846.5	66.944	81.96	153	10000.3	71.335	64.06
34	2047.1	61.751	91.52	94	5913.4	67.026	81.70	154	10071.6	71.399	63.76
35	2108.9	61.842	91.51	95	5980.5	67.108	81.42	155	10143.1	71.463	63.45
36	2170.8	61.934	91.50	96	6047.7	67.189	81.15	156	10214.6	71.526	63.15
37	2232.8	62.025	91.48	97	6114.9	67.270	80.88	157	10286.1	71.589	62.85
38	2294.8	62.117	91.45	98	6182.2	67.351	80.60	158	10357.7	71.652	62.55
39	2357.0	62.208	91.42	99	6249.6	67.431	80.32	159	10429.4	71.714	62.24
40	2419.2	62.299	91.38	100	6317.1	67.511	80.04	160	10501.2	71.776	61.94
41	2481.6	62.391	91.33	101	6384.6	67.591	79.76	161	10573.0	71.838	61.64
42	2544.0	62.482	91.27	102	6452.2	67.671	79.48	162	10644.8	71.900	61.34
43	2606.5	62.573	91.21	103	6520.0	67.750	79.19	163	10716.8	71.961	61.04
44	2669.2	62.664	91.14	104	6587.7	67.829	78.91	164	10788.8	72.022	60.74
45	2731.9	62.756	91.07	105	6655.6	67.908	78.62	165	10860.8	72.082	60.44
46	2794.7	62.847	90.99	106	6723.6	67.987	78.33	166	10932.9	72.143	60.15
47	2857.6	62.938	90.90	107	6791.6	68.065	78.04	167	11005.1	72.203	59.85
48	2920.6	63.028	90.81	108	6859.7	68.143	77.75	168	11077.3	72.262	59.55
49	2983.6	63.119	90.71	109	6927.9	68.220	77.46	169	11149.6	72.322	59.26
50	3046.8	63.210	90.60	110	6996.1	68.298	77.17	170	11222.0	72.381	58.96
51	3110.0	63.300	90.49	111	7064.5	68.375	76.87	171	11294.4	72.440	58.67
52	3173.4	63.391	90.37	112	7132.9	68.451	76.58	172	11366.9	72.498	58.37
53	3236.8	63.481	90.25	113	7201.4	68.528	76.28	173	11439.4	72.557	58.08
54	3300.4	63.571	90.13	114	7269.9	68.604	75.98	174	11512.0	72.614	57.79
55	3364.0	63.661	89.99	115	7338.6	68.680	75.68	175	11584.6	72.672	57.50
56	3427.7	63.751	89.86	116	7407.3	68.755	75.38	176	11657.3	72.729	57.21
57	3491.5	63.841	89.71	117	7476.1	68.831	75.08	177	11730.1	72.787	56.92
58	3555.4	63.931	89.57	118	7545.0	68.905	74.78	178	11802.9	72.843	56.63
59	3619.3	64.020	89.41	119	7613.9	68.980	74.48	179	11875.8	72.900	56.34
60	3683.4	64.110	89.26	120	7682.9	69.054	74.18	180	11948.7	72.956	56.06

TABLE 5.3.2. *Type E thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	11948.7	72.956	56.06	240	16417.2	75.839	40.67	300	21033.1	77.910	28.91
181	12021.7	73.012	55.77	241	16493.0	75.879	40.44	301	21111.1	77.939	28.74
182	12094.7	73.068	55.48	242	16568.9	75.920	40.22	302	21189.0	77.967	28.57
183	12167.8	73.123	55.20	243	16644.9	75.960	40.00	303	21267.0	77.996	28.40
184	12241.0	73.178	54.92	244	16720.8	76.000	39.78	304	21345.0	78.024	28.23
185	12314.2	73.233	54.63	245	16796.8	76.039	39.56	305	21423.0	78.052	28.07
186	12387.4	73.287	54.35	246	16872.9	76.079	39.34	306	21501.1	78.080	27.90
187	12460.7	73.341	54.07	247	16949.0	76.118	39.12	307	21579.2	78.108	27.73
188	12534.1	73.395	53.79	248	17025.1	76.157	38.90	308	21657.3	78.136	27.57
189	12607.5	73.449	53.51	249	17101.3	76.196	38.69	309	21735.5	78.163	27.40
190	12681.0	73.502	53.24	250	17177.5	76.234	38.47	310	21813.6	78.190	27.24
191	12754.5	73.555	52.96	251	17253.8	76.273	38.26	311	21891.8	78.218	27.08
192	12828.1	73.608	52.68	252	17330.1	76.311	38.04	312	21970.1	78.245	26.91
193	12901.7	73.661	52.41	253	17406.4	76.349	37.83	313	22048.3	78.271	26.75
194	12975.4	73.713	52.13	254	17482.8	76.387	37.62	314	22126.6	78.298	26.59
195	13049.2	73.765	51.86	255	17559.2	76.424	37.41	315	22204.9	78.325	26.43
196	13123.0	73.817	51.59	256	17635.6	76.461	37.20	316	22283.3	78.351	26.27
197	13196.8	73.868	51.32	257	17712.1	76.499	36.99	317	22361.6	78.377	26.11
198	13270.7	73.919	51.05	258	17788.6	76.535	36.79	318	22440.0	78.403	25.95
199	13344.6	73.970	50.78	259	17865.2	76.572	36.58	319	22518.4	78.429	25.79
200	13418.6	74.021	50.51	260	17941.8	76.609	36.38	320	22596.9	78.455	25.64
201	13492.7	74.071	50.24	261	18018.4	76.645	36.17	321	22675.4	78.480	25.48
202	13566.8	74.121	49.98	262	18095.1	76.681	35.97	322	22753.8	78.506	25.32
203	13640.9	74.171	49.71	263	18171.8	76.717	35.77	323	22832.4	78.531	25.17
204	13715.1	74.221	49.45	264	18248.5	76.752	35.57	324	22910.9	78.556	25.01
205	13789.4	74.270	49.19	265	18325.3	76.788	35.37	325	22989.5	78.581	24.86
206	13863.7	74.319	48.93	266	18402.1	76.823	35.17	326	23068.1	78.606	24.70
207	13938.0	74.368	48.67	267	18478.9	76.858	34.97	327	23146.7	78.630	24.55
208	14012.4	74.417	48.41	268	18555.8	76.893	34.77	328	23225.3	78.655	24.39
209	14086.8	74.465	48.15	269	18632.7	76.928	34.57	329	23304.0	78.679	24.24
210	14161.3	74.513	47.89	270	18709.6	76.962	34.38	330	23382.7	78.703	24.09
211	14235.9	74.561	47.63	271	18786.6	76.997	34.18	331	23461.4	78.727	23.94
212	14310.5	74.608	47.38	272	18863.6	77.031	33.99	332	23540.1	78.751	23.79
213	14385.1	74.655	47.12	273	18940.7	77.065	33.80	333	23618.9	78.775	23.64
214	14459.8	74.702	46.87	274	19017.8	77.098	33.61	334	23697.7	78.798	23.49
215	14534.5	74.749	46.62	275	19094.9	77.132	33.41	335	23776.5	78.822	23.34
216	14609.3	74.796	46.37	276	19172.0	77.165	33.22	336	23855.3	78.845	23.19
217	14684.1	74.842	46.12	277	19249.2	77.198	33.03	337	23934.2	78.868	23.04
218	14758.9	74.888	45.87	278	19326.4	77.231	32.85	338	24013.1	78.891	22.89
219	14833.9	74.934	45.62	279	19403.7	77.264	32.66	339	24092.0	78.914	22.75
220	14908.8	74.979	45.37	280	19480.9	77.296	32.47	340	24170.9	78.937	22.60
221	14983.8	75.024	45.13	281	19558.3	77.329	32.29	341	24249.8	78.959	22.45
222	15058.9	75.069	44.88	282	19635.6	77.361	32.10	342	24328.8	78.982	22.31
223	15134.0	75.114	44.64	283	19713.0	77.393	31.92	343	24407.8	79.004	22.16
224	15209.1	75.159	44.40	284	19790.4	77.425	31.73	344	24486.8	79.026	22.02
225	15284.3	75.203	44.16	285	19867.8	77.457	31.55	345	24565.9	79.048	21.87
226	15359.5	75.247	43.92	286	19945.3	77.488	31.37	346	24644.9	79.070	21.73
227	15434.8	75.291	43.68	287	20022.8	77.519	31.19	347	24724.0	79.091	21.58
228	15510.1	75.334	43.44	288	20100.3	77.550	31.01	348	24803.1	79.113	21.44
229	15585.4	75.378	43.20	289	20177.9	77.581	30.83	349	24882.2	79.134	21.30
230	15660.8	75.421	42.97	290	20255.5	77.612	30.65	350	24961.4	79.155	21.15
231	15736.3	75.464	42.73	291	20333.1	77.643	30.47	351	25040.5	79.177	21.01
232	15811.8	75.506	42.50	292	20410.8	77.673	30.30	352	25119.7	79.197	20.87
233	15887.3	75.549	42.27	293	20488.5	77.703	30.12	353	25198.9	79.218	20.73
234	15962.9	75.591	42.03	294	20566.2	77.733	29.94	354	25278.2	79.239	20.59
235	16038.5	75.633	41.80	295	20643.9	77.763	29.77	355	25357.4	79.259	20.45
236	16114.1	75.674	41.57	296	20721.7	77.793	29.60	356	25436.7	79.280	20.31
237	16189.8	75.716	41.35	297	20799.5	77.822	29.42	357	25516.0	79.300	20.17
238	16265.6	75.757	41.12	298	20877.4	77.852	29.25	358	25595.3	79.320	20.03
239	16341.3	75.798	40.89	299	20955.2	77.881	29.08	359	25674.6	79.340	19.89
240	16417.2	75.839	40.67	300	21033.1	77.910	28.91	360	25754.0	79.360	19.75

TABLE 5.3.2. *Type E thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	25754.0	79.360	19.75	420	30546.3	80.307	11.97	480	35381.9	80.810	4.92
361	25833.3	79.380	19.61	421	30626.6	80.319	11.84	481	35462.7	80.815	4.81
362	25912.7	79.399	19.48	422	30706.9	80.331	11.72	482	35543.6	80.820	4.70
363	25992.1	79.419	19.34	423	30787.3	80.342	11.60	483	35624.4	80.825	4.59
364	26071.6	79.438	19.20	424	30867.6	80.354	11.48	484	35705.2	80.829	4.48
365	26151.0	79.457	19.06	425	30948.0	80.365	11.35	485	35786.0	80.834	4.37
366	26230.5	79.476	18.93	426	31028.4	80.377	11.23	486	35866.9	80.838	4.26
367	26310.0	79.495	18.79	427	31108.7	80.388	11.11	487	35947.7	80.842	4.15
368	26389.5	79.514	18.66	428	31189.1	80.399	10.99	488	36028.6	80.846	4.04
369	26469.0	79.532	18.52	429	31269.5	80.410	10.87	489	36109.4	80.850	3.93
370	26548.5	79.551	18.39	430	31349.9	80.420	10.75	490	36190.3	80.854	3.82
371	26628.1	79.569	18.25	431	31430.4	80.431	10.63	491	36271.1	80.858	3.71
372	26707.7	79.587	18.12	432	31510.8	80.442	10.51	492	36352.0	80.861	3.60
373	26787.3	79.605	17.98	433	31591.3	80.452	10.39	493	36432.8	80.865	3.49
374	26866.9	79.623	17.85	434	31671.7	80.463	10.26	494	36513.7	80.868	3.38
375	26946.5	79.641	17.71	435	31752.2	80.473	10.14	495	36594.6	80.872	3.27
376	27026.2	79.659	17.58	436	31832.7	80.483	10.02	496	36675.4	80.875	3.16
377	27105.8	79.676	17.45	437	31913.1	80.493	9.90	497	36756.3	80.878	3.06
378	27185.5	79.693	17.32	438	31993.6	80.503	9.78	498	36837.2	80.881	2.95
379	27265.2	79.711	17.18	439	32074.2	80.512	9.67	499	36918.1	80.884	2.84
380	27344.9	79.728	17.05	440	32154.7	80.522	9.55	500	36999.0	80.887	2.73
381	27424.7	79.745	16.92	441	32235.2	80.531	9.43	501	37079.9	80.889	2.63
382	27504.4	79.762	16.79	442	32315.7	80.541	9.31	502	37160.8	80.892	2.52
383	27584.2	79.778	16.66	443	32396.3	80.550	9.19	503	37241.6	80.894	2.41
384	27664.0	79.795	16.53	444	32476.8	80.559	9.07	504	37322.5	80.897	2.31
385	27743.8	79.811	16.39	445	32557.4	80.568	8.95	505	37403.4	80.899	2.20
386	27823.6	79.828	16.26	446	32638.0	80.577	8.83	506	37484.3	80.901	2.10
387	27903.4	79.844	16.13	447	32718.6	80.586	8.72	507	37565.2	80.903	1.99
388	27983.3	79.860	16.00	448	32799.1	80.594	8.60	508	37646.1	80.905	1.88
389	28063.2	79.876	15.87	449	32879.7	80.603	8.48	509	37727.1	80.907	1.78
390	28143.0	79.892	15.74	450	32960.3	80.611	8.36	510	37808.0	80.909	1.68
391	28222.9	79.907	15.62	451	33041.0	80.620	8.24	511	37888.9	80.910	1.57
392	28302.9	79.923	15.49	452	33121.6	80.628	8.13	512	37969.8	80.912	1.47
393	28382.8	79.938	15.36	453	33202.2	80.636	8.01	513	38050.7	80.913	1.36
394	28462.7	79.954	15.23	454	33282.9	80.644	7.89	514	38131.6	80.915	1.26
395	28542.7	79.969	15.10	455	33363.5	80.652	7.78	515	38212.5	80.916	1.16
396	28622.7	79.984	14.97	456	33444.2	80.660	7.66	516	38293.4	80.917	1.05
397	28702.7	79.999	14.85	457	33524.8	80.667	7.54	517	38374.4	80.918	0.95
398	28782.7	80.014	14.72	458	33605.5	80.675	7.43	518	38455.3	80.919	0.85
399	28862.7	80.028	14.59	459	33686.2	80.682	7.31	519	38536.2	80.920	0.75
400	28942.7	80.043	14.46	460	33766.9	80.689	7.20	520	38617.1	80.920	0.64
401	29022.8	80.057	14.34	461	33847.6	80.696	7.08	521	38698.0	80.921	0.54
402	29102.8	80.071	14.21	462	33928.3	80.703	6.97	522	38779.0	80.921	0.44
403	29182.9	80.086	14.08	463	34009.0	80.710	6.85	523	38859.9	80.922	0.34
404	29263.0	80.100	13.96	464	34089.7	80.717	6.74	524	38940.8	80.922	0.24
405	29343.1	80.113	13.83	465	34170.4	80.724	6.62	525	39021.7	80.922	0.14
406	29423.2	80.127	13.71	466	34251.1	80.730	6.51	526	39102.6	80.922	0.04
407	29503.4	80.141	13.58	467	34331.9	80.737	6.39	527	39183.6	80.922	-0.06
408	29583.5	80.154	13.46	468	34412.6	80.743	6.28	528	39264.5	80.922	-0.16
409	29663.7	80.168	13.33	469	34493.3	80.749	6.16	529	39345.4	80.922	-0.26
410	29743.9	80.181	13.21	470	34574.1	80.755	6.05	530	39426.3	80.922	-0.36
411	29824.0	80.194	13.08	471	34654.9	80.761	5.94	531	39507.3	80.921	-0.45
412	29904.2	80.207	12.96	472	34735.6	80.767	5.82	532	39588.2	80.921	-0.55
413	29984.5	80.220	12.83	473	34816.4	80.773	5.71	533	39669.1	80.920	-0.65
414	30064.7	80.233	12.71	474	34897.2	80.779	5.60	534	39750.0	80.919	-0.75
415	30144.9	80.246	12.58	475	34977.9	80.784	5.48	535	39830.9	80.919	-0.84
416	30225.2	80.258	12.46	476	35058.7	80.790	5.37	536	39911.9	80.918	-0.94
417	30305.4	80.270	12.34	477	35139.5	80.795	5.26	537	39992.8	80.917	-1.04
418	30385.7	80.283	12.21	478	35220.3	80.800	5.15	538	40073.7	80.916	-1.13
419	30466.0	80.295	12.09	479	35301.1	80.805	5.03	539	40154.6	80.915	-1.23
420	30546.3	80.307	11.97	480	35381.9	80.810	4.92	540	40235.5	80.913	-1.33

TABLE 5.3.2. *Type E thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	40235.5	80.913	-1.33	600	45084.7	80.676	-6.36	660	49911.5	80.181	-9.89
541	40316.4	80.912	-1.42	601	45165.4	80.669	-6.43	661	49991.6	80.171	-9.94
542	40397.3	80.910	-1.52	602	45246.0	80.663	-6.50	662	50071.8	80.161	-9.98
543	40478.2	80.909	-1.61	603	45326.7	80.656	-6.57	663	50151.9	80.151	-10.03
544	40559.2	80.907	-1.70	604	45407.3	80.650	-6.64	664	50232.1	80.141	-10.08
545	40640.1	80.905	-1.80	605	45488.0	80.643	-6.71	665	50312.2	80.131	-10.12
546	40721.0	80.904	-1.89	606	45568.6	80.636	-6.78	666	50392.4	80.121	-10.17
547	40801.9	80.902	-1.98	607	45649.3	80.629	-6.85	667	50472.5	80.111	-10.21
548	40882.8	80.900	-2.08	608	45729.9	80.623	-6.91	668	50552.6	80.100	-10.25
549	40963.7	80.898	-2.17	609	45810.5	80.616	-6.98	669	50632.7	80.090	-10.30
550	41044.6	80.895	-2.26	610	45891.1	80.609	-7.05	670	50712.8	80.080	-10.34
551	41125.5	80.893	-2.35	611	45971.7	80.602	-7.12	671	50792.8	80.069	-10.39
552	41206.4	80.891	-2.44	612	46052.3	80.594	-7.18	672	50872.9	80.059	-10.43
553	41287.2	80.888	-2.53	613	46132.9	80.587	-7.25	673	50952.9	80.048	-10.47
554	41368.1	80.886	-2.62	614	46213.5	80.580	-7.31	674	51033.0	80.038	-10.51
555	41449.0	80.883	-2.71	615	46294.1	80.573	-7.38	675	51113.0	80.027	-10.56
556	41529.9	80.880	-2.80	616	46374.6	80.565	-7.45	676	51193.0	80.017	-10.60
557	41610.8	80.877	-2.89	617	46455.2	80.558	-7.51	677	51273.1	80.006	-10.64
558	41691.6	80.874	-2.98	618	46535.8	80.550	-7.57	678	51353.1	79.996	-10.68
559	41772.5	80.871	-3.07	619	46616.3	80.543	-7.64	679	51433.1	79.985	-10.72
560	41853.4	80.868	-3.16	620	46696.8	80.535	-7.70	680	51513.0	79.974	-10.76
561	41934.3	80.865	-3.25	621	46777.4	80.527	-7.76	681	51593.0	79.963	-10.80
562	42015.1	80.862	-3.33	622	46857.9	80.519	-7.83	682	51673.0	79.953	-10.84
563	42096.0	80.858	-3.42	623	46938.4	80.511	-7.89	683	51752.9	79.942	-10.88
564	42176.8	80.855	-3.51	624	47018.9	80.504	-7.95	684	51832.8	79.931	-10.92
565	42257.7	80.851	-3.59	625	47099.4	80.496	-8.01	685	51912.8	79.920	-10.96
566	42338.5	80.848	-3.68	626	47179.9	80.488	-8.07	686	51992.7	79.909	-11.00
567	42419.4	80.844	-3.77	627	47260.4	80.479	-8.13	687	52072.6	79.898	-11.04
568	42500.2	80.840	-3.85	628	47340.9	80.471	-8.19	688	52152.5	79.887	-11.08
569	42581.1	80.836	-3.93	629	47421.3	80.463	-8.25	689	52232.4	79.876	-11.12
570	42661.9	80.832	-4.02	630	47501.8	80.455	-8.31	690	52312.2	79.865	-11.16
571	42742.7	80.828	-4.10	631	47582.2	80.446	-8.37	691	52392.1	79.853	-11.19
572	42823.6	80.824	-4.19	632	47662.7	80.438	-8.43	692	52471.9	79.842	-11.23
573	42904.4	80.820	-4.27	633	47743.1	80.430	-8.48	693	52551.8	79.831	-11.27
574	42985.2	80.816	-4.35	634	47823.5	80.421	-8.54	694	52631.6	79.820	-11.30
575	43066.0	80.811	-4.43	635	47904.0	80.413	-8.60	695	52711.4	79.808	-11.34
576	43146.8	80.807	-4.52	636	47984.4	80.404	-8.65	696	52791.2	79.797	-11.38
577	43227.6	80.802	-4.60	637	48064.8	80.395	-8.71	697	52871.0	79.786	-11.41
578	43308.4	80.797	-4.68	638	48145.2	80.386	-8.77	698	52950.8	79.774	-11.45
579	43389.2	80.793	-4.76	639	48225.5	80.378	-8.82	699	53030.6	79.763	-11.49
580	43470.0	80.788	-4.84	640	48305.9	80.369	-8.88	700	53110.3	79.751	-11.52
581	43550.8	80.783	-4.92	641	48386.3	80.360	-8.93	701	53190.1	79.740	-11.56
582	43631.6	80.778	-5.00	642	48466.6	80.351	-8.98	702	53269.8	79.728	-11.59
583	43712.3	80.773	-5.08	643	48547.0	80.342	-9.04	703	53349.5	79.716	-11.63
584	43793.1	80.768	-5.16	644	48627.3	80.333	-9.09	704	53429.2	79.705	-11.66
585	43873.9	80.763	-5.23	645	48707.7	80.324	-9.14	705	53508.9	79.693	-11.70
586	43954.6	80.757	-5.31	646	48788.0	80.315	-9.20	706	53588.6	79.681	-11.73
587	44035.4	80.752	-5.39	647	48868.3	80.305	-9.25	707	53668.3	79.670	-11.77
588	44116.1	80.747	-5.47	648	48948.6	80.296	-9.30	708	53747.9	79.658	-11.80
589	44196.9	80.741	-5.54	649	49028.9	80.287	-9.35	709	53827.6	79.646	-11.84
590	44277.6	80.736	-5.62	650	49109.2	80.277	-9.40	710	53907.2	79.634	-11.87
591	44358.4	80.730	-5.69	651	49189.4	80.268	-9.45	711	53986.9	79.622	-11.90
592	44439.1	80.724	-5.77	652	49269.7	80.258	-9.50	712	54066.5	79.610	-11.94
593	44519.8	80.718	-5.84	653	49349.9	80.249	-9.55	713	54146.1	79.598	-11.97
594	44600.5	80.713	-5.92	654	49430.2	80.239	-9.60	714	54225.7	79.586	-12.00
595	44681.2	80.707	-5.99	655	49510.4	80.230	-9.65	715	54305.3	79.574	-12.04
596	44761.9	80.701	-6.07	656	49590.6	80.220	-9.70	716	54384.8	79.562	-12.07
597	44842.6	80.694	-6.14	657	49670.9	80.210	-9.75	717	54464.4	79.550	-12.10
598	44923.3	80.688	-6.21	658	49751.1	80.201	-9.80	718	54543.9	79.538	-12.14
599	45004.0	80.682	-6.28	659	49831.3	80.191	-9.84	719	54623.5	79.526	-12.17
600	45084.7	80.676	-6.36	660	49911.5	80.181	-9.89	720	54703.0	79.514	-12.20

TABLE 5.3.2. *Type E thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	54703.0	79.514	-12.20	780	59450.7	78.723	-14.18	840	64147.1	77.799	-16.77
721	54782.5	79.502	-12.23	781	59529.4	78.709	-14.21	841	64224.9	77.782	-16.82
722	54862.0	79.489	-12.27	782	59608.1	78.695	-14.25	842	64302.7	77.766	-16.87
723	54941.5	79.477	-12.30	783	59686.8	78.681	-14.29	843	64380.5	77.749	-16.92
724	55020.9	79.465	-12.33	784	59765.5	78.666	-14.33	844	64458.2	77.732	-16.98
725	55100.4	79.452	-12.36	785	59844.1	78.652	-14.36	845	64535.9	77.715	-17.03
726	55179.8	79.440	-12.40	786	59922.8	78.638	-14.40	846	64613.6	77.698	-17.08
727	55259.3	79.428	-12.43	787	60001.4	78.623	-14.44	847	64691.3	77.681	-17.13
728	55338.7	79.415	-12.46	788	60080.0	78.609	-14.48	848	64769.0	77.663	-17.18
729	55418.1	79.403	-12.49	789	60158.6	78.594	-14.51	849	64846.7	77.646	-17.23
730	55497.5	79.390	-12.52	790	60237.2	78.580	-14.55	850	64924.3	77.629	-17.28
731	55576.9	79.378	-12.56	791	60315.8	78.565	-14.59	851	65001.9	77.612	-17.33
732	55656.3	79.365	-12.59	792	60394.3	78.551	-14.63	852	65079.5	77.594	-17.38
733	55735.6	79.352	-12.62	793	60472.9	78.536	-14.67	853	65157.1	77.577	-17.43
734	55815.0	79.340	-12.65	794	60551.4	78.521	-14.71	854	65234.7	77.559	-17.48
735	55894.3	79.327	-12.68	795	60629.9	78.507	-14.75	855	65312.2	77.542	-17.53
736	55973.6	79.314	-12.72	796	60708.4	78.492	-14.79	856	65389.8	77.524	-17.59
737	56052.9	79.302	-12.75	797	60786.9	78.477	-14.83	857	65467.3	77.507	-17.64
738	56132.2	79.289	-12.78	798	60865.4	78.462	-14.87	858	65544.8	77.489	-17.69
739	56211.5	79.276	-12.81	799	60943.8	78.447	-14.91	859	65622.2	77.471	-17.74
740	56290.8	79.263	-12.84	800	61022.3	78.432	-14.95	860	65699.7	77.454	-17.79
741	56370.0	79.250	-12.87	801	61100.7	78.417	-14.99	861	65777.2	77.436	-17.84
742	56449.3	79.238	-12.91	802	61179.1	78.402	-15.03	862	65854.6	77.418	-17.89
743	56528.5	79.225	-12.94	803	61257.5	78.387	-15.07	863	65932.0	77.400	-17.94
744	56607.7	79.212	-12.97	804	61335.9	78.372	-15.11	864	66009.4	77.382	-17.99
745	56686.9	79.199	-13.00	805	61414.2	78.357	-15.15	865	66086.8	77.364	-18.04
746	56766.1	79.186	-13.03	806	61492.6	78.342	-15.20	866	66164.1	77.346	-18.09
747	56845.3	79.173	-13.07	807	61570.9	78.327	-15.24	867	66241.4	77.328	-18.15
748	56924.5	79.160	-13.10	808	61649.2	78.311	-15.28	868	66318.8	77.310	-18.20
749	57003.6	79.146	-13.13	809	61727.6	78.296	-15.33	869	66396.1	77.291	-18.25
750	57082.8	79.133	-13.16	810	61805.8	78.281	-15.37	870	66473.3	77.273	-18.30
751	57161.9	79.120	-13.19	811	61884.1	78.265	-15.41	871	66550.6	77.255	-18.34
752	57241.0	79.107	-13.23	812	61962.4	78.250	-15.46	872	66627.9	77.236	-18.39
753	57320.1	79.094	-13.26	813	62040.6	78.235	-15.50	873	66705.1	77.218	-18.44
754	57399.2	79.080	-13.29	814	62118.8	78.219	-15.54	874	66782.3	77.200	-18.49
755	57478.3	79.067	-13.32	815	62197.1	78.203	-15.59	875	66859.5	77.181	-18.54
756	57557.3	79.054	-13.36	816	62275.2	78.188	-15.63	876	66936.7	77.162	-18.59
757	57636.4	79.040	-13.39	817	62353.4	78.172	-15.68	877	67013.8	77.144	-18.64
758	57715.4	79.027	-13.42	818	62431.6	78.157	-15.72	878	67091.0	77.125	-18.68
759	57794.4	79.014	-13.46	819	62509.7	78.141	-15.77	879	67168.1	77.106	-18.73
760	57873.4	79.000	-13.49	820	62587.9	78.125	-15.81	880	67245.2	77.088	-18.78
761	57952.4	78.987	-13.52	821	62666.0	78.109	-15.86	881	67322.2	77.069	-18.82
762	58031.4	78.973	-13.55	822	62744.1	78.093	-15.91	882	67399.3	77.050	-18.87
763	58110.4	78.959	-13.59	823	62822.2	78.077	-15.95	883	67476.3	77.031	-18.92
764	58189.3	78.946	-13.62	824	62900.2	78.061	-16.00	884	67553.4	77.012	-18.96
765	58268.3	78.932	-13.66	825	62978.3	78.045	-16.05	885	67630.4	76.993	-19.01
766	58347.2	78.919	-13.69	826	63056.3	78.029	-16.09	886	67707.3	76.974	-19.05
767	58426.1	78.905	-13.72	827	63134.4	78.013	-16.14	887	67784.3	76.955	-19.09
768	58505.0	78.891	-13.76	828	63212.4	77.997	-16.19	888	67861.3	76.936	-19.14
769	58583.9	78.877	-13.79	829	63290.4	77.981	-16.24	889	67938.2	76.917	-19.18
770	58662.7	78.863	-13.83	830	63368.3	77.964	-16.28	890	68015.1	76.898	-19.22
771	58741.6	78.850	-13.86	831	63446.3	77.948	-16.33	891	68092.0	76.878	-19.26
772	58820.4	78.836	-13.89	832	63524.2	77.932	-16.38	892	68168.8	76.859	-19.30
773	58899.3	78.822	-13.93	833	63602.1	77.915	-16.43	893	68245.7	76.840	-19.34
774	58978.1	78.808	-13.96	834	63680.1	77.899	-16.48	894	68322.5	76.820	-19.38
775	59056.9	78.794	-14.00	835	63757.9	77.882	-16.53	895	68399.3	76.801	-19.42
776	59135.7	78.780	-14.04	836	63835.8	77.866	-16.58	896	68476.1	76.782	-19.46
777	59214.5	78.766	-14.07	837	63913.7	77.849	-16.63	897	68552.9	76.762	-19.49
778	59293.2	78.752	-14.11	838	63991.5	77.833	-16.67	898	68629.6	76.743	-19.53
779	59372.0	78.738	-14.14	839	64069.3	77.816	-16.72	899	68706.4	76.723	-19.56
780	59450.7	78.723	-14.18	840	64147.1	77.799	-16.77	900	68783.1	76.704	-19.60

TABLE 5.3.2. *Type E thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	68783.1	76.704	-19.60	935	71455.6	76.006	-19.91	970	74103.9	75.346	-17.07
901	68859.8	76.684	-19.63	936	71531.5	75.986	-19.88	971	74179.3	75.329	-16.91
902	68936.5	76.664	-19.66	937	71607.5	75.967	-19.86	972	74254.6	75.312	-16.75
903	69013.1	76.645	-19.69	938	71683.5	75.947	-19.83	973	74329.9	75.296	-16.59
904	69089.8	76.625	-19.72	939	71759.4	75.927	-19.79	974	74405.2	75.279	-16.42
905	69166.4	76.605	-19.75	940	71835.3	75.907	-19.76	975	74480.5	75.263	-16.24
906	69243.0	76.585	-19.78	941	71911.2	75.887	-19.72	976	74555.7	75.247	-16.06
907	69319.5	76.566	-19.80	942	71987.1	75.868	-19.67	977	74631.0	75.231	-15.87
908	69396.1	76.546	-19.83	943	72063.0	75.848	-19.63	978	74706.2	75.215	-15.68
909	69472.6	76.526	-19.85	944	72138.8	75.828	-19.58	979	74781.4	75.199	-15.48
910	69549.1	76.506	-19.88	945	72214.6	75.809	-19.53	980	74856.6	75.184	-15.28
911	69625.6	76.486	-19.90	946	72290.4	75.789	-19.48	981	74931.7	75.169	-15.06
912	69702.1	76.466	-19.92	947	72366.2	75.770	-19.42	982	75006.9	75.154	-14.85
913	69778.6	76.446	-19.94	948	72442.0	75.751	-19.36	983	75082.1	75.139	-14.63
914	69855.0	76.426	-19.95	949	72517.7	75.731	-19.30	984	75157.2	75.125	-14.40
915	69931.4	76.406	-19.97	950	72593.4	75.712	-19.23	985	75232.3	75.110	-14.16
916	70007.8	76.386	-19.98	951	72669.1	75.693	-19.16	986	75307.4	75.096	-13.92
917	70084.2	76.366	-20.00	952	72744.8	75.674	-19.09	987	75382.5	75.083	-13.67
918	70160.6	76.346	-20.01	953	72820.5	75.655	-19.01	988	75457.6	75.069	-13.41
919	70236.9	76.326	-20.02	954	72896.1	75.636	-18.93	989	75532.6	75.056	-13.15
920	70313.2	76.306	-20.03	955	72971.7	75.617	-18.84	990	75607.7	75.043	-12.88
921	70389.5	76.286	-20.03	956	73047.4	75.598	-18.75	991	75682.7	75.030	-12.61
922	70465.8	76.266	-20.04	957	73122.9	75.579	-18.66	992	75757.7	75.017	-12.32
923	70542.0	76.246	-20.04	958	73198.5	75.561	-18.56	993	75832.8	75.005	-12.03
924	70618.3	76.226	-20.04	959	73274.1	75.542	-18.46	994	75907.8	74.993	-11.73
925	70694.5	76.206	-20.04	960	73349.6	75.524	-18.36	995	75982.7	74.982	-11.43
926	70770.7	76.186	-20.04	961	73425.1	75.505	-18.25	996	76057.7	74.971	-11.11
927	70846.9	76.166	-20.03	962	73500.6	75.487	-18.14	997	76132.7	74.960	-10.79
928	70923.0	76.146	-20.02	963	73576.1	75.469	-18.02	998	76207.6	74.949	-10.46
929	70999.2	76.126	-20.01	964	73651.5	75.451	-17.90	999	76282.6	74.939	-10.12
930	71075.3	76.106	-20.00	965	73727.0	75.433	-17.77	1000	76357.5	74.929	-9.78
931	71151.4	76.086	-19.99	966	73802.4	75.416	-17.64				
932	71227.4	76.066	-19.97	967	73877.8	75.398	-17.51				
933	71303.5	76.046	-19.95	968	73953.2	75.381	-17.37				
934	71379.5	76.026	-19.93	969	74028.6	75.363	-17.22				
935	71455.6	76.006	-19.91	970	74103.9	75.346	-17.07				

TABLE 5.3.3. *Thermoelectric values at the fixed points for Type E thermocouples*

Fixed point	Temp. °C	E μV	S $\mu V/^{\circ}C$	dS/dT $nV/^{\circ}C^2$
Helium NBP	-268.935	-9833.09	2.084	491.21
Hydrogen TP	-259.340	-9792.66	6.180	388.66
Hydrogen NBP	-252.870	-9744.75	8.608	366.90
Neon TP	-248.595	-9704.62	10.181	359.97
Neon NBP	-246.048	-9677.58	11.073	356.26
Oxygen TP	-218.789	-9249.87	20.018	294.12
Nitrogen TP	-210.002	-9062.90	22.507	272.80
Nitrogen NBP	-195.802	-8716.78	26.181	246.34
Oxygen NBP	-182.962	-8360.81	29.230	229.48
Carbon Dioxide SP	-78.476	-4227.53	48.541	149.61
Mercury FP	-38.862	-2193.03	54.039	128.82
Ice point*	0.000	0.00	58.696	86.22
Ether TP	26.870	1609.1	61.099	91.33
Water BP	100.000	6317.1	67.512	80.04
Benzoic TP	122.370	7846.8	89.229	73.46
Indium FP	156.634	10259.9	71.566	62.96
Tin FP	231.9681	15809.4	75.505	42.51
Bismuth FP	271.442	18820.7	77.012	34.10
Cadmium FP	321.108	22683.9	78.483	25.46
Lead FP	327.502	23186.2	78.643	24.47
Mercury BP	356.660	25489.1	79.293	20.22
Zinc FP	419.580	30512.6	80.301	12.02
Sulphur BP	444.674	32531.2	80.565	8.99
Cu-Al FP	548.23	40901.4	80.899	-2.10
Antimony FP	630.74	47561.4	80.449	-8.35
Aluminum FP	660.37	49941.2	80.177	-9.91
Silver FP	961.93	73495.5	75.489	-18.15

*Junction point of different functions.

TABLE 5.3.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type E thermocouples*

Temperature range	Degree	Estimated maximum error in micro volts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-270 to -200 °C	13	(*)	300	0.4	0.1	<0.01
-200 to 0 °C	13	800	20	0.2	0.02	<0.01
0 to 200 °C	9	3	0.2	<0.01	<0.01	<0.01
200 to 400 °C	9	7	0.2	<0.01	<0.01	<0.01
400 to 600 °C	9	70	0.5	0.03	<0.01	<0.01
600 to 800 °C	9	400	15	0.2	0.02	<0.01
800 to 1000 °C	9	(*)	90	0.6	0.1	<0.01

*A high-order polynomial with a low-bit machine causes extreme error.

6. TYPE J—Iron Versus *Copper-Nickel Alloy* (SAMA) Thermocouples

6.1. Material Specifications and Precautions

This is one of the most common types of industrial thermocouples, because of its relatively high Seebeck coefficient and low cost. It has been reported that more than 200 tons of Type J materials are supplied annually to industry in this country. However, it is least suitable for accurate thermometry because there are significant nonlinear deviations in the thermoelectric output from different manufacturers. These irregular deviations lead to difficulties in obtaining accurate calibrations based on a limited number of calibration points. The positive thermoelement is commercially pure (99.5% Fe) iron, usually containing significant impurity levels of carbon, chromium, copper, manganese, nickel, phosphorus, silicon, and sulfur. Thermocouple wire represents such a small fraction of the total production of commercial iron wire that the producers do not control the chemical composition to maintain constant thermoelectric properties. Instead, instrument companies and thermocouple fabricators select material most suitable for their thermocouple usage. The total and specific types of impurities that occur in commercial iron change with time, location of primary ores, and methods of smelting. Many unusual lots have been selected in the past, for example spools of industrial iron wire and even scrapped rails from an elevated train line. At present, iron wire that most closely fits these tables has about 0.25 percent Mn and 0.12 percent copper plus other minor impurities.

The negative thermoelement for Type J thermocouples is a *copper-nickel alloy* known ambiguously as constantan. The word constantan has commonly referred to copper-nickel alloys with anything from 45 to 60 percent of copper, often with minor impurities of carbon, iron, or manganese. Constantan for Type J thermocouples usually contains about 55 percent copper, 45 percent nickel, and a small but thermoelectrically significant amount of iron and manganese, about 0.1 percent or more. **It should be emphasized that Type JN thermoelements are NOT generally interchangeable with Type TN (or EN) thermoelements, although they are all referred to as "constantan".** In order to provide some differentiation in nomenclature, Type JN is often referred to as SAMA constantan.

Suppliers of Type J thermocouples usually select heats of iron and well-matched batches of constantan so that the total output of the combination closely fits the Type J table up to 760 °C. In fact, with care in selection, Type J thermocouples can be produced that will fit calibration tables as accurately as the more expensive Type K thermocouples. While the overall thermocouple will conform to the limits of error published in ASTM or ISA standards (or even have closer limits of error), it should be emphasized that Type JP and JN thermoelements as supplied by different companies are *not* generally interchangeable.

The grandfather of the Type J thermocouple tables in this Monograph was the commercial table printed

by Leeds and Northrup in 1913 and incorporated in a later NBS paper, Foote, Fairchild, and Harrison [1920] and the NAS-NRC International Critical Tables [1926]. They covered the range from 0 to 760 °C. The usefulness of an iron versus *copper-nickel alloy* thermocouple had been shown as early as [1892] by Lindeck. By the 1930's a number of different tables had been published for iron versus constantan thermocouples because of a lack of standardization and differences in the irons used by various thermocouple manufacturers. Although other tables for iron versus constantan thermocouples came into existence, the 1913 table was the most commonly used for instrument calibrations. Until the late 1930's however, thermocouples did not conform accurately to this curve. Therefore Roeser and Dahl [1938] obtained a representative selection of both materials and carefully remeasured their thermoelectric properties between -200 and 1000 °C. Their results were representative of material used by the military at that time, but deviated significantly from the 1913 table. Because the new tables differed by up to 2 percent from the previous tables, they were not generally accepted as a replacement for the earlier iron versus constantan tables. To somewhat ease the confusion, the tables generated by Roeser and Dahl [1938] were referred to as Type Y or RP 1080 iron versus constantan. Their tables were used by several military groups but were not generally used in civilian applications.

In an effort to promote uniformity, a section of the Scientific Apparatus Makers of America (SAMA) initiated a new program in 1948. A research project was established at the National Bureau of Standards and the results were published in 1953 by Corruccini and Shenker. The resultant tables were very close to the 1913 ones and have generally been accepted as the Type J, iron versus constantan, thermocouple standards (NBS Circular 561; Shenker et al. [1955]). After modifications for temperature scale changes, their research results were used for generating the functions given in this Monograph.

Type J thermocouples are recommended by the ASTM [1970] for use in the temperature range from 0 to 760 °C in vacuum, oxidizing, reducing, or inert atmospheres. If used for extended times above 500 °C, heavy gage wires are recommended because the oxidation rate is rapid at elevated temperatures. The ASTM Manual STP 470 [1970] indicates the following restrictions on the use of Type J thermocouples:

They should not be used in sulfurous atmospheres above 500 °C. Because of potential rusting and embrittlement, they are not recommended for sub-zero temperatures. They should not be cycled above 760 °C even for a short time if accurate readings below 760 °C are desired at a later time.

The positive thermoelement, iron, is relatively insensitive to composition changes under thermal neutron irradiation, but does exhibit a slight increase in manganese content. The negative thermoelement, a

copper-nickel alloy, is subject to substantial composition changes under thermal neutron irradiation since copper is converted to nickel and zinc.

Both thermoelements of Type J thermocouples are variable in thermoelectric output because of compositional variations in the iron and in the copper-nickel alloy. Corruccini and Shenker [1953] found an order of magnitude variation in both the manganese (0.03 to 0.38%) and copper (0.02 to 0.15%) impurities in the iron thermoelements, even though the materials were presumably specially selected lots of material. Not only were the thermoelectric voltages of different iron thermoelements different by as much as 2 percent, the output curves were sometimes different in shape. The negative thermoelements also differed by as much as 2 percent, but their deviations tended to be much more linear. At present the manufacturers are controlling the compositions and the matching of thermoelements more carefully and therefore deviations from the standards should be considerably less than those observed by Corruccini and Shenker [1953].

Finch [1943] has shown that the Seebeck coefficient of iron at 500 °C is increased by additions of Cr, Mn, or S but decreased by additions of Ni, Si, Sn, P, and Cu (for impurity level above 0.1 percent). Manufacturers select the negative thermoelement to match a given lot of positive material. The composition of the copper-nickel alloy therefore also varies significantly. The average composition is around 55 percent copper and there is usually a significant impurity amount of iron.

Annealing below 760 °C for short periods does not significantly alter the thermoelectric properties of Type J thermocouples.

Commercial iron undergoes a magnetic transformation near 769 °C and a α - γ crystal transformation near 910 °C (see Hansen and Anderko [1958]). Both of these transformations, especially the latter, seriously affect the thermoelectric properties of iron, and therefore of Type J thermocouples. It is for that reason that iron versus constantan thermocouples are not recommended as a standardized type above 760 °C. If Type J thermocouples are taken to high temperatures, especially above 900 °C, they will lose the accuracy of their calibration when they are recycled to lower temperatures. If Type J thermocouples are used at temperatures above 760 °C, only the largest wire, AWG 8 (3.3 mm) should be used and they should be held at the measured temperature for 10 to 20 minutes before readings are taken. The output of the Type J thermocouples may change by as much as 40 μ V (or 1 °C equivalent) per minute when first brought up to temperatures near 900 °C.

ASTM Standard E230-72 in the Annual Book of ASTM Standards [1972] specifies that the standard limits of error for Type J commercial thermocouples be ± 2.2 °C between 0 and 277 °C and $\pm \frac{3}{4}$ percent between 277 and 760 °C. Limits of error are not specified for Type J thermocouples below 0 °C or above 760 °C. Type J thermocouples can also be supplied to meet special limits of error, which are equal to one-half the limits given above. The recommended upper temperature limit for protected thermo-

couples, 760 °C, applies to AWG 8 (3.3 mm) wire. For smaller wires the recommended upper temperature decreases to 593 °C for AWG 14 (1.6 mm), 482 °C for AWG 20 (0.8 mm), and 371 °C for AWG 24 or 28 (0.5 or 0.3 mm).

6.2. Data Analyses and Comparisons

The fitting functions for Type J thermocouples are based primarily on the data reported by Corruccini and Shenker [1953]. The values for single thermoelements versus platinum were adjusted to be on the IPTS-68 and to be relative to the new platinum reference standard, Pt-67. The differences between Pt-67 and the former standard, Pt-27, are summarized in section 1.2. The method of analysis used in this Monograph was different than that used by Corruccini and Shenker [1953]; they used divided differences, Lagrangian interpolation, and linear interpolation to construct their tables from the experimental data points. Our methods are described in the first chapter of this Monograph. The high temperature functions for the Type J thermocouple have also been adjusted to fit some recent experimental points in the extended range near 1135 °C reported by Sine [1971].

Thermocouple A-1 in the paper by Corruccini and Shenker [1953] was used as the basis for fitting the functions for Type J thermocouples between -210 and +760 °C. There were 27 experimental points in this temperature range. With a seven term function the standard deviation of the fit was 4.8 μ V.

Twenty-three experimental points for the thermoelement A-1 in the paper by Corruccini and Shenker [1953] were used to generate functions for Type JP thermoelements versus Pt-67. With a seven term function the standard deviation of the fit was 4.4 μ V.

The fitting function for Pt-67 versus Type JN thermoelements was obtained by subtraction of the Type JP function from the Type J function.

Fitting functions for Type J thermocouples between 760 and 1200 °C were based upon 11 experimental points from Corruccini and Shenker [1953] and eight experimental points provided by Sine [1971]. The function was extrapolated smoothly above the highest experimental points (near 1134 °C) to 1200 °C. The function was constrained to have the same thermoelectric voltage and Seebeck coefficient at 760 °C as those calculated for the temperature range below 760 °C. The standard deviation of the fit for a 6 term equation was about 14 μ V. The function and values for Type J thermocouples above 760 °C are thus not suitable for precise temperature measurements and the thermocouple should not be used as a standardized type above 760 °C. The values for temperatures above 760 °C given in this Monograph should be used only as a guide and rough approximation.

Values for thermoelectric voltages of Type J thermocouples given in this Monograph were compared to those for three thermocouples, A-1, F-1, and F-5, studied by Corruccini and Shenker [1953] and to those for three thermocouples calibrated by the Temperature Section of the National Bureau of Standards, Gaithersburg. The deviations are shown in figure 6.2.1. All values were adjusted to the IPTS-68.

Similarly, the deviations for Type JP thermoelements versus Pt-67 and Pt-67 versus JN thermoelements are given in figures 6.2.2 and 6.2.3. The number of thermoelements used for these comparisons was different however: values for four JP thermoelements calibrated by the Temperature Section of the National Bureau of Standards, Gaithersburg, are shown; for JN, no individual calibrations from that group are included. In both these figures there is also a comparison to data for the thermoelements of thermocouple

A-1 from Corruccini and Shenker [1953] and to values from the widely distributed, but unpublished, industrial tables prepared by Burns [1967].

Deviations between values given in this Monograph and those given in NBS Circular 561 are shown in figure 6.2.4. The earlier values were adjusted to the IPTS-68. The width of the curve indicates the round-off uncertainty ($10\text{ }\mu\text{V}$) in the tabular values given in NBS Circular 561.

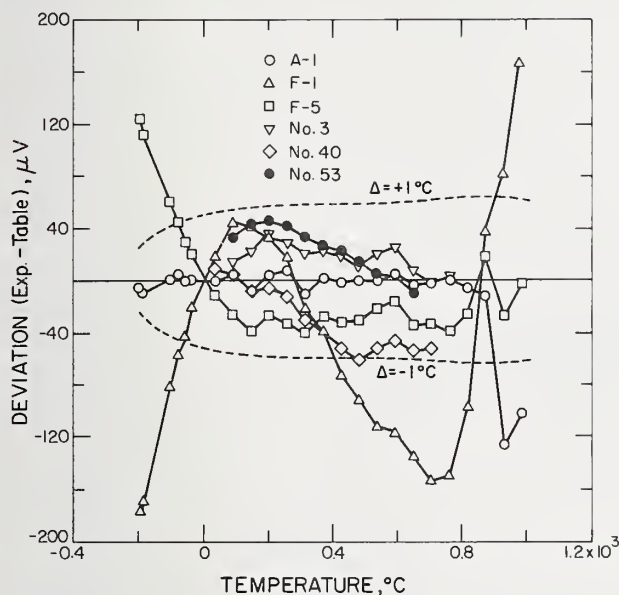


FIGURE 6.2.1. Deviations of thermoelectric voltages of Type J thermocouples—comparison of values given in this Monograph to those given by: A-1, F-1, and F-5, Corruccini and Shenker [1953]; Nos. 3, 40, and 53, selected calibrations from the Temperature Section (NBS, Gaithersburg).

Values from previous publications and tests are adjusted to the IPTS-68. The dashed lines indicate a deviation of $1\text{ }^{\circ}\text{C}$.

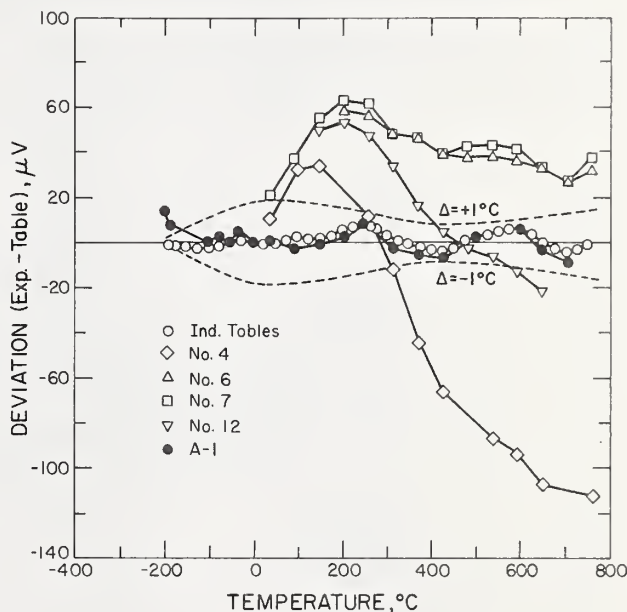


FIGURE 6.2.2. Deviations of thermoelectric voltages of Type JP thermoelements versus platinum, Pt-67—comparison of values given in this Monograph to those given by: A-1, Corruccini and Shenker [1953], Nos. 4, 6, 7, and 12, selected calibrations from the Temperature Section (NBS, Gaithersburg); Ind. Tables, unpublished NBS data by Burns [1967].

Values from previous publications and tests are adjusted to the IPTS-68. The dashed lines indicate a deviation of $1\text{ }^{\circ}\text{C}$.

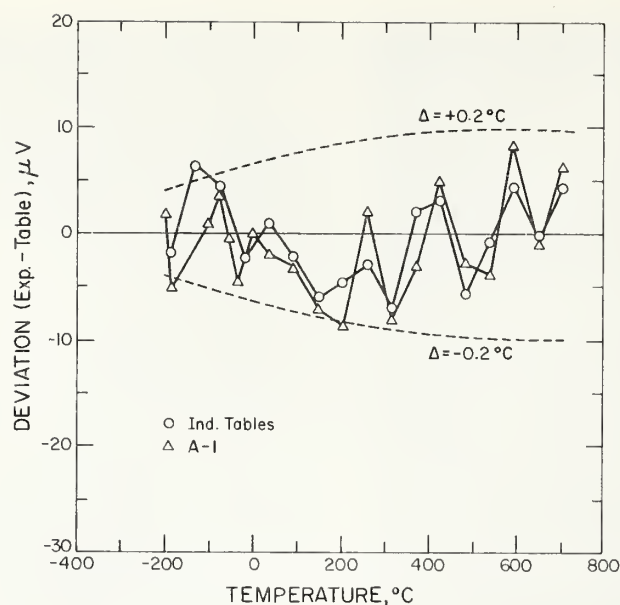


FIGURE 6.2.3. Deviations of thermoelectric voltages of platinum, Pt-67, versus Type JN thermoelements—comparison of values given in this Monograph to those given by: A-1, Corruccini and Shenker [1953]; Ind. Tables, unpublished NBS data by Burns [1967].

Values from previous publications and tests are expressed on the IPTS-68. The dashed lines indicate a deviation of 0.2 °C.

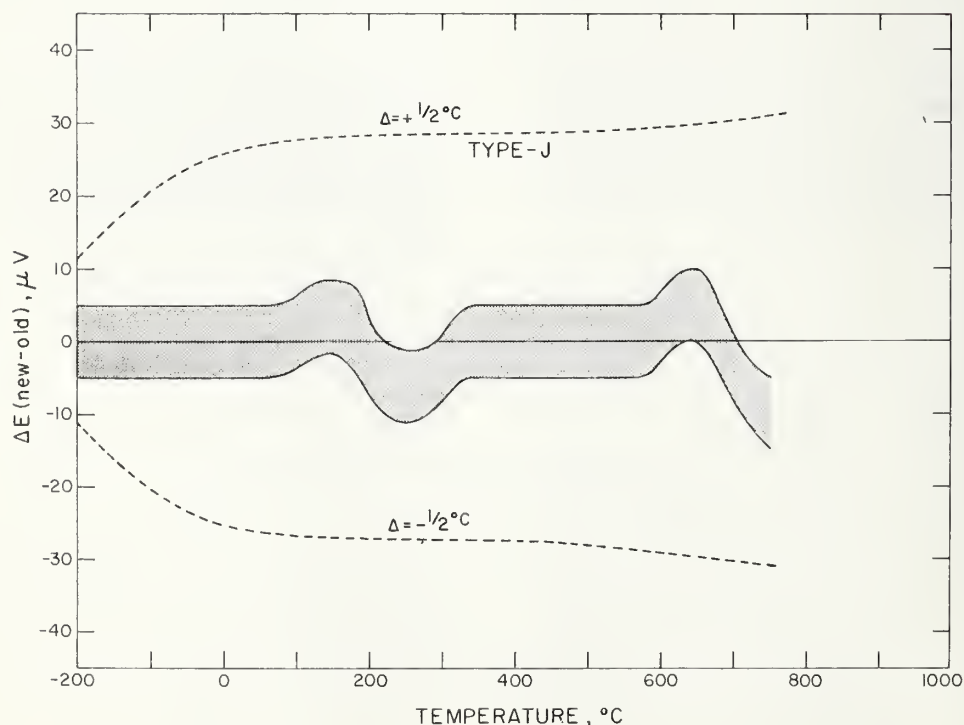


FIGURE 6.2.4. Difference in the thermoelectric voltages for Type J thermocouples—comparison of values given in this Monograph to those given in NBS Circular 561.

Values from the previous standard are adjusted to the IPTS-68. The dashed lines indicate a deviation of $\frac{1}{2}$ °C.

6.3. Reference Functions and Tables for Type J Thermocouples

The coefficients for the seventh degree expansion for the thermoelectric voltage of Type J thermocouples below 760 °C are given in table 6.3.1. The coefficients for the fifth degree expansion above 760 °C are also given in table 6.3.1. The errors caused by reduced bit arithmetic for calculating values of the functions are given in table 6.3.4.

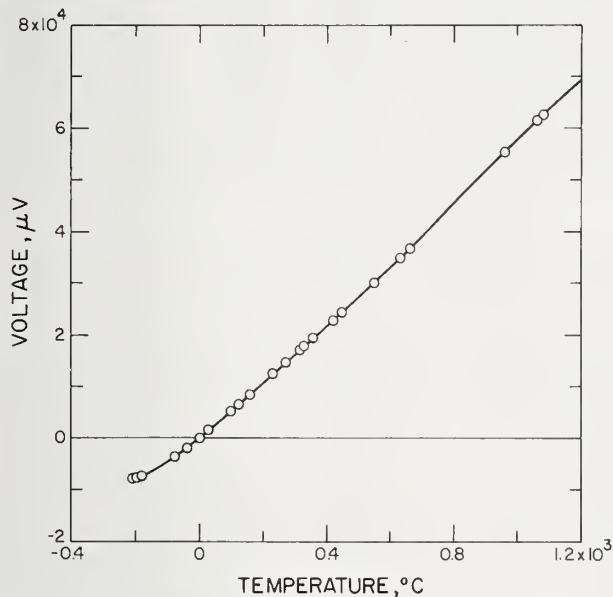


FIGURE 6.3.1. Thermoelectric voltage for Type J thermocouples. The circles indicate values at various thermometric fixed points on the IPTS-68.

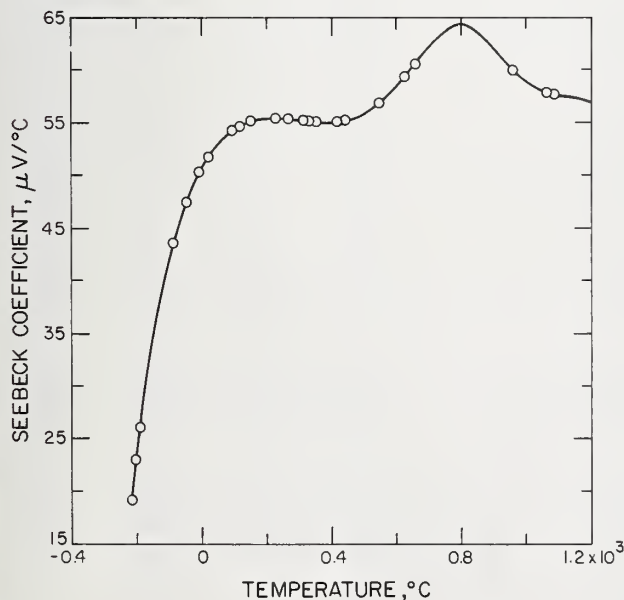


FIGURE 6.3.2. Seebeck coefficient for Type J thermocouples. The circles indicate values at various thermometric fixed points on the IPTS-68.

The primary reference values for Type J thermocouples are given in table 6.3.2. Values at selected fixed points are given in table 6.3.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 6.3.1, 6.3.2, and 6.3.3, respectively.

Values above 760 °C are given as a guide only: thermoelectric properties of Type J thermocouples are not stable above 760 °C and the thermocouple should NOT be considered to be a standardized type above this temperature.

TABLE 6.3.1. Power series expansion for the thermoelectric voltage of Type J thermocouples

Temperature range	Degree	Coefficients	Term
-210 to 760 °C	7	5.0372753027×10^1	T
		$3.0425491284 \times 10^{-2}$	T^2
		$-8.5669750464 \times 10^{-5}$	T^3
		$1.3348825735 \times 10^{-7}$	T^4
		$-1.7022405966 \times 10^{-10}$	T^5
		$1.9416091001 \times 10^{-13}$	T^6
		$-9.6391844859 \times 10^{-17}$	T^7
760 to 1200 °C	5	2.9721751778×10^5	...
		$-1.5059632873 \times 10^3$	T
		3.2051064215	T^2
		$-3.2210174230 \times 10^{-3}$	T^3
		$1.5949968788 \times 10^{-6}$	T^4
		$-3.1239801752 \times 10^{-10}$	T^5

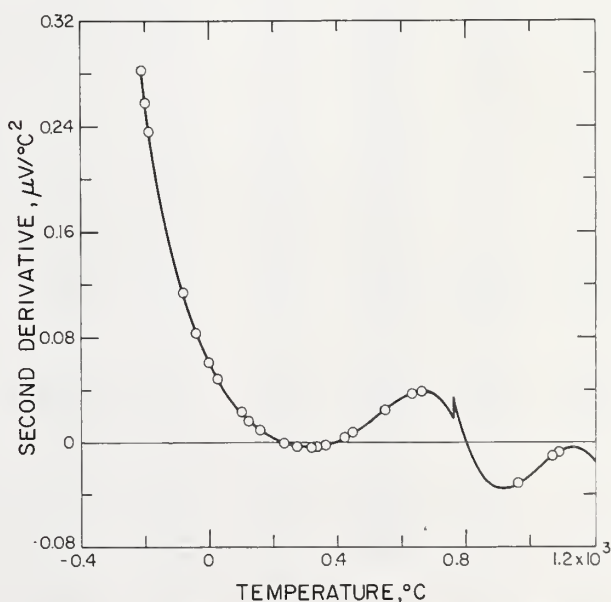


FIGURE 6.3.3. Second derivative of thermoelectric voltage for Type J thermocouples. The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 6.3.2. *Type J thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-210	-8095.6	19.126	283.95	-200	-7890.5	21.873	265.58	-190	-7658.7	24.441	248.29
-209	-8076.3	19.409	282.06	-199	-7868.5	22.137	263.80	-189	-7634.2	24.689	246.61
-208	-8056.8	19.690	280.19	-198	-7846.2	22.400	262.04	-188	-7609.4	24.934	244.95
-207	-8037.0	19.969	278.32	-197	-7823.7	22.662	260.28	-187	-7584.3	25.179	243.30
-206	-8016.9	20.247	276.47	-196	-7800.9	22.921	258.54	-186	-7559.0	25.421	241.66
-205	-7996.5	20.522	274.63	-195	-7777.8	23.179	256.80	-185	-7533.5	25.662	240.02
-204	-7975.8	20.796	272.79	-194	-7754.5	23.435	255.08	-184	-7507.7	25.901	238.40
-203	-7954.9	21.068	270.97	-193	-7730.9	23.689	253.37	-183	-7481.7	26.139	236.79
-202	-7933.7	21.338	269.17	-192	-7707.1	23.941	251.66	-182	-7455.4	26.375	235.19
-201	-7912.2	21.606	267.37	-191	-7683.1	24.192	249.97	-181	-7428.9	26.609	233.59
-200	-7890.5	21.873	265.58	-190	-7658.7	24.441	248.29	-180	-7402.2	26.842	232.01

TABLE 6.3.2. *Type J thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-180	-7402.2	26.842	232.01	-120	-5426.0	38.240	152.79	-60	-2892.5	45.669	98.27
-179	-7375.2	27.073	230.44	-119	-5387.7	38.392	151.70	-59	-2846.7	45.767	97.53
-178	-7348.0	27.303	228.87	-118	-5349.3	38.543	150.63	-58	-2800.9	45.864	96.79
-177	-7320.6	27.531	227.32	-117	-5310.6	38.693	149.55	-57	-2755.0	45.961	96.05
-176	-7293.0	27.757	225.77	-116	-5271.9	38.842	148.49	-56	-2709.0	46.056	95.32
-175	-7265.1	27.982	224.23	-115	-5233.0	38.990	147.43	-55	-2662.9	46.151	94.59
-174	-7237.0	28.206	222.71	-114	-5193.9	39.137	146.37	-54	-2616.7	46.245	93.87
-173	-7208.7	28.428	221.19	-113	-5154.7	39.283	145.33	-53	-2570.4	46.339	93.15
-172	-7180.2	28.648	219.68	-112	-5115.3	39.428	144.29	-52	-2524.0	46.432	92.43
-171	-7151.4	28.867	218.18	-111	-5075.8	39.571	143.25	-51	-2477.5	46.524	91.72
-170	-7122.4	29.085	216.69	-110	-5036.2	39.714	142.22	-50	-2431.0	46.615	91.02
-169	-7093.2	29.301	215.21	-109	-4996.4	39.856	141.20	-49	-2384.3	46.706	90.32
-168	-7063.8	29.515	213.74	-108	-4956.5	39.996	140.19	-48	-2337.6	46.796	89.62
-167	-7034.2	29.728	212.28	-107	-4916.4	40.136	139.18	-47	-2290.7	46.885	88.93
-166	-7004.4	29.940	210.83	-106	-4876.2	40.275	138.18	-46	-2243.8	46.974	88.24
-165	-6974.3	30.150	209.38	-105	-4835.9	40.413	137.18	-45	-2196.8	47.062	87.56
-164	-6944.1	30.358	207.94	-104	-4795.4	40.549	136.19	-44	-2149.7	47.149	86.88
-163	-6913.6	30.566	206.52	-103	-4754.8	40.685	135.21	-43	-2102.5	47.235	86.21
-162	-6882.9	30.771	205.10	-102	-4714.0	40.820	134.23	-42	-2055.2	47.321	85.54
-161	-6852.1	30.976	203.69	-101	-4673.1	40.953	133.26	-41	-2007.8	47.406	84.87
-160	-6821.0	31.179	202.29	-100	-4632.1	41.086	132.30	-40	-1960.4	47.491	84.21
-159	-6789.7	31.380	200.90	-99	-4590.9	41.218	131.34	-39	-1912.9	47.575	83.55
-158	-6758.2	31.581	199.51	-98	-4549.7	41.349	130.39	-38	-1865.2	47.658	82.90
-157	-6726.6	31.779	198.14	-97	-4508.2	41.479	129.44	-37	-1817.5	47.741	82.25
-156	-6694.7	31.977	196.77	-96	-4466.7	41.608	128.50	-36	-1769.8	47.823	81.60
-155	-6662.6	32.173	195.41	-95	-4425.0	41.736	127.56	-35	-1721.9	47.904	80.96
-154	-6630.3	32.368	194.06	-94	-4383.2	41.863	126.63	-34	-1673.9	47.985	80.32
-153	-6597.9	32.561	192.72	-93	-4341.3	41.989	125.71	-33	-1625.9	48.065	79.69
-152	-6565.2	32.753	191.38	-92	-4299.3	42.114	124.79	-32	-1577.8	48.144	79.06
-151	-6532.4	32.944	190.06	-91	-4257.1	42.239	123.88	-31	-1529.6	48.223	78.43
-150	-6499.3	33.133	188.74	-90	-4214.8	42.362	122.98	-30	-1481.4	48.301	77.81
-149	-6466.1	33.321	187.43	-89	-4172.4	42.485	122.08	-29	-1433.0	48.378	77.19
-148	-6432.7	33.508	186.13	-88	-4129.8	42.606	121.18	-28	-1384.6	48.455	76.58
-147	-6399.1	33.694	184.84	-87	-4087.1	42.727	120.29	-27	-1336.1	48.531	75.97
-146	-6365.3	33.878	183.55	-86	-4044.4	42.847	119.41	-26	-1287.6	48.607	75.36
-145	-6331.3	34.061	182.28	-85	-4001.4	42.966	118.53	-25	-1238.9	48.682	74.76
-144	-6297.2	34.242	181.01	-84	-3958.4	43.084	117.66	-24	-1190.2	48.757	74.16
-143	-6262.8	34.423	179.75	-83	-3915.3	43.201	116.79	-23	-1141.4	48.830	73.56
-142	-6228.3	34.602	178.49	-82	-3872.0	43.317	115.93	-22	-1092.5	48.904	72.97
-141	-6193.6	34.780	177.25	-81	-3828.6	43.433	115.07	-21	-1043.6	48.976	72.38
-140	-6158.8	34.956	176.01	-80	-3785.2	43.548	114.22	-20	-994.6	49.049	71.80
-139	-6123.7	35.132	174.78	-79	-3741.6	43.661	113.37	-19	-945.5	49.120	71.22
-138	-6088.5	35.306	173.55	-78	-3697.8	43.774	112.53	-18	-896.3	49.191	70.64
-137	-6053.1	35.479	172.34	-77	-3654.0	43.886	111.70	-17	-847.1	49.261	70.07
-136	-6017.5	35.651	171.13	-76	-3610.1	43.998	110.87	-16	-797.8	49.331	69.50
-135	-5981.8	35.821	169.93	-75	-3566.0	44.108	110.04	-15	-748.4	49.400	68.93
-134	-5945.9	35.990	168.74	-74	-3521.8	44.218	109.22	-14	-699.0	49.469	68.37
-133	-5909.8	36.159	167.55	-73	-3477.6	44.327	108.41	-13	-649.5	49.537	67.81
-132	-5873.6	36.326	166.37	-72	-3433.2	44.435	107.60	-12	-599.9	49.605	67.26
-131	-5837.2	36.491	165.20	-71	-3388.7	44.542	106.80	-11	-550.3	49.672	66.70
-130	-5800.6	36.656	164.04	-70	-3344.1	44.648	106.00	-10	-500.6	49.738	66.15
-129	-5763.9	36.819	162.88	-69	-3299.4	44.754	105.20	-9	-450.8	49.804	65.61
-128	-5727.0	36.982	161.73	-68	-3254.6	44.859	104.41	-8	-401.0	49.869	65.07
-127	-5689.9	37.143	160.59	-67	-3209.7	44.963	103.63	-7	-351.1	49.934	64.53
-126	-5652.7	37.303	159.46	-66	-3164.7	45.066	102.85	-6	-301.1	49.998	63.99
-125	-5615.3	37.462	158.33	-65	-3119.6	45.168	102.07	-5	-251.1	50.062	63.46
-124	-5577.8	37.620	157.21	-64	-3074.3	45.270	101.30	-4	-201.0	50.125	62.93
-123	-5540.1	37.776	156.09	-63	-3029.0	45.371	100.54	-3	-150.8	50.188	62.41
-122	-5502.2	37.932	154.99	-62	-2983.6	45.471	99.78	-2	-100.6	50.250	61.89
-121	-5464.2	38.086	153.88	-61	-2938.1	45.571	99.02	-1	-50.3	50.312	61.37
-120	-5426.0	38.240	152.79	-60	-2892.5	45.669	98.27	0	0.0	50.373	60.85

TABLE 6.3.2. *Type J thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.0	50.373	60.85	60	3115.0	53.204	35.11	120	6358.8	54.747	17.46
1	50.4	50.433	60.34	61	3168.2	53.239	34.76	121	6413.6	54.764	17.22
2	100.9	50.493	59.83	62	3221.5	53.273	34.41	122	6468.3	54.782	16.98
3	151.4	50.553	59.32	63	3274.8	53.308	34.06	123	6523.1	54.798	16.75
4	202.0	50.612	58.82	64	3328.1	53.341	33.72	124	6577.9	54.815	16.51
5	252.6	50.671	58.32	65	3381.4	53.375	33.37	125	6632.8	54.831	16.28
6	303.3	50.729	57.82	66	3434.8	53.408	33.03	126	6687.6	54.848	16.05
7	354.1	50.786	57.33	67	3488.3	53.441	32.69	127	6742.5	54.864	15.81
8	404.9	50.843	56.84	68	3541.7	53.474	32.35	128	6797.3	54.879	15.59
9	455.8	50.900	56.35	69	3595.2	53.506	32.02	129	6852.2	54.895	15.36
10	506.7	50.956	55.87	70	3648.7	53.538	31.68	130	6907.1	54.910	15.13
11	557.7	51.012	55.39	71	3702.3	53.569	31.35	131	6962.0	54.925	14.91
12	608.7	51.067	54.91	72	3755.9	53.600	31.02	132	7017.0	54.940	14.69
13	659.8	51.122	54.43	73	3809.5	53.631	30.70	133	7071.9	54.954	14.47
14	711.0	51.176	53.96	74	3863.1	53.662	30.37	134	7126.9	54.969	14.25
15	762.2	51.229	53.49	75	3916.8	53.692	30.05	135	7181.8	54.983	14.03
16	813.4	51.283	53.02	76	3970.5	53.722	29.73	136	7236.8	54.997	13.81
17	864.7	51.335	52.56	77	4024.3	53.751	29.41	137	7291.8	55.010	13.60
18	916.1	51.388	52.10	78	4078.0	53.781	29.09	138	7346.9	55.024	13.38
19	967.5	51.440	51.64	79	4131.8	53.810	28.78	139	7401.9	55.037	13.17
20	1019.0	51.491	51.19	80	4185.6	53.838	28.46	140	7456.9	55.050	12.96
21	1070.5	51.542	50.73	81	4239.5	53.866	28.15	141	7512.0	55.063	12.75
22	1122.0	51.593	50.28	82	4293.4	53.894	27.84	142	7567.1	55.076	12.55
23	1173.7	51.643	49.84	83	4347.3	53.922	27.54	143	7622.1	55.088	12.34
24	1225.3	51.692	49.39	84	4401.2	53.950	27.23	144	7677.2	55.100	12.14
25	1277.0	51.741	48.95	85	4455.2	53.977	26.93	145	7732.3	55.113	11.93
26	1328.8	51.790	48.51	86	4509.2	54.003	26.63	146	7787.5	55.124	11.73
27	1380.6	51.838	48.08	87	4563.2	54.030	26.33	147	7842.6	55.136	11.53
28	1432.5	51.886	47.64	88	4617.2	54.056	26.03	148	7897.7	55.147	11.33
29	1484.4	51.934	47.21	89	4671.3	54.082	25.73	149	7952.9	55.159	11.14
30	1536.4	51.981	46.78	90	4725.4	54.107	25.44	150	8008.1	55.170	10.94
31	1588.4	52.027	46.36	91	4779.5	54.133	25.15	151	8063.2	55.181	10.75
32	1640.4	52.073	45.94	92	4833.7	54.158	24.86	152	8118.4	55.191	10.55
33	1692.5	52.119	45.52	93	4887.8	54.183	24.57	153	8173.6	55.202	10.36
34	1744.6	52.164	45.10	94	4942.0	54.207	24.28	154	8228.8	55.212	10.17
35	1796.8	52.209	44.69	95	4996.2	54.231	24.00	155	8284.0	55.222	9.98
36	1849.1	52.254	44.27	96	5050.5	54.255	23.72	156	8339.3	55.232	9.80
37	1901.3	52.298	43.86	97	5104.8	54.279	23.44	157	8394.5	55.242	9.61
38	1953.7	52.342	43.46	98	5159.0	54.302	23.16	158	8449.7	55.251	9.43
39	2006.0	52.385	43.05	99	5213.4	54.325	22.88	159	8505.0	55.260	9.25
40	2058.4	52.428	42.65	100	5267.7	54.348	22.61	160	8560.3	55.270	9.06
41	2110.9	52.470	42.25	101	5322.1	54.370	22.33	161	8615.5	55.279	8.88
42	2163.4	52.512	41.85	102	5376.4	54.392	22.06	162	8670.8	55.287	8.71
43	2215.9	52.554	41.46	103	5430.8	54.414	21.79	163	8726.1	55.296	8.53
44	2268.5	52.595	41.07	104	5485.3	54.436	21.52	164	8781.4	55.304	8.35
45	2321.1	52.636	40.68	105	5539.7	54.457	21.25	165	8836.7	55.313	8.18
46	2373.8	52.676	40.29	106	5594.2	54.478	20.99	166	8892.0	55.321	8.00
47	2426.4	52.717	39.90	107	5648.7	54.499	20.73	167	8947.4	55.329	7.83
48	2479.2	52.756	39.52	108	5703.2	54.520	20.47	168	9002.7	55.336	7.66
49	2532.0	52.796	39.14	109	5757.7	54.540	20.21	169	9058.0	55.344	7.49
50	2584.8	52.835	38.76	110	5812.3	54.560	19.95	170	9113.4	55.351	7.33
51	2637.6	52.873	38.39	111	5866.8	54.580	19.69	171	9168.7	55.359	7.16
52	2690.5	52.911	38.02	112	5921.4	54.600	19.44	172	9224.1	55.366	6.99
53	2743.5	52.949	37.65	113	5976.0	54.619	19.18	173	9279.5	55.373	6.83
54	2796.4	52.987	37.28	114	6030.7	54.638	18.93	174	9334.8	55.379	6.67
55	2849.4	53.024	36.91	115	6085.3	54.657	18.68	175	9390.2	55.386	6.51
56	2902.5	53.060	36.55	116	6140.0	54.675	18.44	176	9445.6	55.392	6.35
57	2955.5	53.097	36.18	117	6194.6	54.694	18.19	177	9501.0	55.399	6.19
58	3008.7	53.133	35.83	118	6249.4	54.712	17.94	178	9556.4	55.405	6.03
59	3061.8	53.168	35.47	119	6304.1	54.730	17.70	179	9611.8	55.411	5.88
60	3115.0	53.204	35.11	120	6358.8	54.747	17.46	180	9667.2	55.417	5.72

TABLE 6.3.2. *Type J thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	9667.2	55.417	5.72	240	12997.7	55.529	-1.21	300	16325.1	55.359	-3.76
181	9722.7	55.422	5.57	241	13053.2	55.528	-1.29	301	16380.5	55.355	-3.77
182	9778.1	55.428	5.42	242	13108.7	55.527	-1.36	302	16435.8	55.351	-3.78
183	9833.5	55.433	5.27	243	13164.3	55.526	-1.44	303	16491.2	55.348	-3.78
184	9888.9	55.438	5.12	244	13219.8	55.524	-1.51	304	16546.5	55.344	-3.78
185	9944.4	55.443	4.97	245	13275.3	55.522	-1.59	305	16601.9	55.340	-3.79
186	9999.8	55.448	4.82	246	13330.8	55.521	-1.66	306	16657.2	55.336	-3.79
187	10055.3	55.453	4.68	247	13386.4	55.519	-1.73	307	16712.5	55.332	-3.78
188	10110.7	55.458	4.54	248	13441.9	55.517	-1.80	308	16767.9	55.329	-3.78
189	10166.2	55.462	4.39	249	13497.4	55.516	-1.87	309	16823.2	55.325	-3.78
190	10221.7	55.466	4.25	250	13552.9	55.514	-1.93	310	16878.5	55.321	-3.78
191	10277.1	55.470	4.11	251	13608.4	55.512	-2.00	311	16933.8	55.317	-3.77
192	10332.6	55.475	3.97	252	13663.9	55.510	-2.06	312	16989.1	55.314	-3.76
193	10388.1	55.478	3.84	253	13719.4	55.508	-2.13	313	17044.5	55.310	-3.76
194	10443.6	55.482	3.70	254	13775.0	55.505	-2.19	314	17099.8	55.306	-3.75
195	10499.0	55.486	3.56	255	13830.5	55.503	-2.25	315	17155.1	55.302	-3.74
196	10554.5	55.489	3.43	256	13886.0	55.501	-2.31	316	17210.4	55.299	-3.73
197	10610.0	55.493	3.30	257	13941.5	55.499	-2.37	317	17265.7	55.295	-3.71
198	10665.5	55.496	3.17	258	13997.0	55.496	-2.43	318	17321.0	55.291	-3.70
199	10721.0	55.499	3.04	259	14052.5	55.494	-2.48	319	17376.2	55.287	-3.69
200	10776.5	55.502	2.91	260	14107.9	55.491	-2.54	320	17431.5	55.284	-3.67
201	10832.0	55.505	2.78	261	14163.4	55.489	-2.59	321	17486.8	55.280	-3.65
202	10887.5	55.508	2.66	262	14218.9	55.486	-2.64	322	17542.1	55.276	-3.63
203	10943.0	55.510	2.53	263	14274.4	55.483	-2.70	323	17597.4	55.273	-3.61
204	10998.5	55.513	2.41	264	14329.9	55.481	-2.75	324	17652.6	55.269	-3.59
205	11054.1	55.515	2.29	265	14385.4	55.478	-2.79	325	17707.9	55.266	-3.57
206	11109.6	55.517	2.17	266	14440.8	55.475	-2.84	326	17763.2	55.262	-3.55
207	11165.1	55.519	2.05	267	14496.3	55.472	-2.89	327	17818.4	55.259	-3.52
208	11220.6	55.521	1.93	268	14551.8	55.469	-2.93	328	17873.7	55.255	-3.50
209	11276.1	55.523	1.81	269	14607.3	55.466	-2.98	329	17928.9	55.252	-3.47
210	11331.7	55.525	1.69	270	14662.7	55.463	-3.02	330	17984.2	55.248	-3.45
211	11387.2	55.527	1.58	271	14718.2	55.460	-3.06	331	18039.4	55.245	-3.42
212	11442.7	55.528	1.47	272	14773.6	55.457	-3.11	332	18094.7	55.241	-3.39
213	11498.2	55.530	1.35	273	14829.1	55.454	-3.14	333	18149.9	55.238	-3.36
214	11553.8	55.531	1.24	274	14884.6	55.451	-3.18	334	18205.2	55.235	-3.32
215	11609.3	55.532	1.13	275	14940.0	55.448	-3.22	335	18260.4	55.231	-3.29
216	11664.8	55.533	1.03	276	14995.4	55.444	-3.26	336	18315.6	55.228	-3.26
217	11720.4	55.534	0.92	277	15050.9	55.441	-3.29	337	18370.8	55.225	-3.22
218	11775.9	55.535	0.81	278	15106.3	55.438	-3.32	338	18426.1	55.221	-3.18
219	11831.4	55.536	0.71	279	15161.8	55.435	-3.36	339	18481.3	55.218	-3.14
220	11887.0	55.536	0.60	280	15217.2	55.431	-3.39	340	18536.5	55.215	-3.11
221	11942.5	55.537	0.50	281	15272.6	55.428	-3.42	341	18591.7	55.212	-3.06
222	11998.0	55.537	0.40	282	15328.1	55.424	-3.45	342	18646.9	55.209	-3.02
223	12053.6	55.538	0.30	283	15383.5	55.421	-3.48	343	18702.1	55.206	-2.98
224	12109.1	55.538	0.20	284	15438.9	55.417	-3.50	344	18757.3	55.203	-2.94
225	12164.7	55.538	0.11	285	15494.3	55.414	-3.53	345	18812.5	55.200	-2.89
226	12220.2	55.538	0.01	286	15549.7	55.410	-3.55	346	18867.7	55.197	-2.85
227	12275.7	55.538	-0.09	287	15605.1	55.407	-3.57	347	18922.9	55.195	-2.80
228	12331.3	55.538	-0.18	288	15660.5	55.403	-3.60	348	18978.1	55.192	-2.75
229	12386.8	55.538	-0.27	289	15715.9	55.400	-3.62	349	19033.3	55.189	-2.70
230	12442.4	55.537	-0.36	290	15771.3	55.396	-3.64	350	19088.5	55.186	-2.65
231	12497.9	55.537	-0.45	291	15826.7	55.392	-3.65	351	19143.7	55.184	-2.60
232	12553.4	55.537	-0.54	292	15882.1	55.389	-3.67	352	19198.9	55.181	-2.54
233	12609.0	55.536	-0.63	293	15937.5	55.385	-3.69	353	19254.1	55.179	-2.49
234	12664.5	55.535	-0.72	294	15992.9	55.381	-3.70	354	19309.2	55.176	-2.43
235	12720.0	55.535	-0.80	295	16048.3	55.378	-3.72	355	19364.4	55.174	-2.38
236	12775.6	55.534	-0.88	296	16103.6	55.374	-3.73	356	19419.6	55.171	-2.32
237	12831.1	55.533	-0.97	297	16159.0	55.370	-3.74	357	19474.7	55.169	-2.26
238	12886.6	55.532	-1.05	298	16214.4	55.366	-3.75	358	19529.9	55.167	-2.20
239	12942.2	55.531	-1.13	299	16269.7	55.363	-3.76	359	19585.1	55.165	-2.14
240	12997.7	55.529	-1.21	300	16325.1	55.359	-3.76	360	19640.2	55.163	-2.08

TABLE 6.3.2. *Type J thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	19640.2	55.163	-2.08	420	22949.1	55.190	3.64	480	26272.1	55.667	12.73
361	19695.4	55.161	-2.02	421	23004.3	55.194	3.77	481	26327.8	55.680	12.90
362	19750.6	55.159	-1.95	422	23059.5	55.198	3.90	482	26383.5	55.693	13.08
363	19805.7	55.157	-1.89	423	23114.7	55.202	4.02	483	26439.2	55.706	13.25
364	19860.9	55.155	-1.82	424	23169.9	55.206	4.15	484	26494.9	55.720	13.43
365	19916.0	55.153	-1.75	425	23225.1	55.210	4.28	485	26550.6	55.733	13.60
366	19971.2	55.151	-1.68	426	23280.3	55.215	4.42	486	26606.4	55.747	13.78
367	20026.3	55.150	-1.61	427	23335.5	55.219	4.55	487	26662.1	55.761	13.95
368	20081.5	55.148	-1.54	428	23390.8	55.224	4.68	488	26717.9	55.775	14.13
369	20136.6	55.147	-1.47	429	23446.0	55.228	4.82	489	26773.7	55.789	14.31
370	20191.8	55.145	-1.40	430	23501.2	55.233	4.95	490	26829.5	55.804	14.49
371	20246.9	55.144	-1.32	431	23556.5	55.238	5.09	491	26885.3	55.818	14.66
372	20302.1	55.142	-1.25	432	23611.7	55.243	5.22	492	26941.1	55.833	14.84
373	20357.2	55.141	-1.17	433	23666.9	55.249	5.36	493	26996.9	55.848	15.02
374	20412.3	55.140	-1.09	434	23722.2	55.254	5.50	494	27052.8	55.863	15.20
375	20467.5	55.139	-1.01	435	23777.5	55.260	5.64	495	27108.7	55.878	15.38
376	20522.6	55.138	-0.93	436	23832.7	55.265	5.78	496	27164.5	55.894	15.56
377	20577.8	55.137	-0.85	437	23888.0	55.271	5.92	497	27220.4	55.909	15.74
378	20632.9	55.136	-0.77	438	23943.3	55.277	6.06	498	27276.4	55.925	15.92
379	20688.0	55.136	-0.69	439	23998.5	55.283	6.21	499	27332.3	55.941	16.10
380	20743.2	55.135	-0.60	440	24053.8	55.290	6.35	500	27388.2	55.957	16.28
381	20798.3	55.135	-0.52	441	24109.1	55.296	6.49	501	27444.2	55.974	16.47
382	20853.4	55.134	-0.43	442	24164.4	55.303	6.64	502	27500.2	55.990	16.65
383	20908.6	55.134	-0.34	443	24219.7	55.309	6.79	503	27556.2	56.007	16.83
384	20963.7	55.133	-0.25	444	24275.0	55.316	6.93	504	27612.2	56.024	17.01
385	21018.8	55.133	-0.16	445	24330.4	55.323	7.08	505	27668.2	56.041	17.20
386	21074.0	55.133	-0.07	446	24385.7	55.330	7.23	506	27724.3	56.058	17.38
387	21129.1	55.133	0.02	447	24441.0	55.338	7.38	507	27780.4	56.076	17.56
388	21184.2	55.133	0.11	448	24496.4	55.345	7.53	508	27836.4	56.093	17.75
389	21239.4	55.133	0.21	449	24551.7	55.353	7.68	509	27892.5	56.111	17.93
390	21294.5	55.133	0.30	450	24607.1	55.361	7.83	510	27948.7	56.129	18.12
391	21349.6	55.134	0.40	451	24662.4	55.368	7.99	511	28004.8	56.148	18.30
392	21404.8	55.134	0.50	452	24717.8	55.376	8.14	512	28061.0	56.166	18.49
393	21459.9	55.135	0.60	453	24773.2	55.385	8.30	513	28117.1	56.185	18.67
394	21515.0	55.135	0.69	454	24828.6	55.393	8.45	514	28173.3	56.203	18.86
395	21570.2	55.136	0.80	455	24884.0	55.402	8.61	515	28229.5	56.222	19.04
396	21625.3	55.137	0.90	456	24939.4	55.410	8.76	516	28285.8	56.241	19.23
397	21680.5	55.138	1.00	457	24994.8	55.419	8.92	517	28342.0	56.261	19.41
398	21735.6	55.139	1.10	458	25050.2	55.428	9.08	518	28398.3	56.280	19.60
399	21790.7	55.140	1.21	459	25105.6	55.437	9.24	519	28454.6	56.300	19.79
400	21845.9	55.141	1.31	460	25161.1	55.447	9.40	520	28510.9	56.320	19.97
401	21901.0	55.143	1.42	461	25216.5	55.456	9.56	521	28567.2	56.340	20.16
402	21956.2	55.144	1.53	462	25272.0	55.466	9.72	522	28623.6	56.360	20.34
403	22011.3	55.146	1.64	463	25327.5	55.476	9.88	523	28679.9	56.381	20.53
404	22066.5	55.148	1.75	464	25383.0	55.486	10.04	524	28736.3	56.401	20.72
405	22121.6	55.149	1.86	465	25438.4	55.496	10.21	525	28792.7	56.422	20.90
406	22176.8	55.151	1.97	466	25493.9	55.506	10.37	526	28849.2	56.443	21.09
407	22231.9	55.153	2.08	467	25549.5	55.516	10.54	527	28905.6	56.464	21.28
408	22287.1	55.155	2.20	468	25605.0	55.527	10.70	528	28962.1	56.485	21.46
409	22342.2	55.158	2.31	469	25660.5	55.538	10.87	529	29018.6	56.507	21.65
410	22397.4	55.160	2.43	470	25716.1	55.549	11.03	530	29075.1	56.529	21.84
411	22452.5	55.163	2.54	471	25771.6	55.560	11.20	531	29131.7	56.551	22.02
412	22507.7	55.165	2.66	472	25827.2	55.571	11.37	532	29188.2	56.573	22.21
413	22562.9	55.168	2.78	473	25882.7	55.583	11.54	533	29244.8	56.595	22.40
414	22618.0	55.171	2.90	474	25938.3	55.594	11.71	534	29301.4	56.618	22.58
415	22673.2	55.174	3.02	475	25993.9	55.606	11.88	535	29358.0	56.640	22.77
416	22728.4	55.177	3.14	476	26049.5	55.618	12.05	536	29414.7	56.663	22.95
417	22783.6	55.180	3.27	477	26105.2	55.630	12.22	537	29471.4	56.686	23.14
418	22838.7	55.183	3.39	478	26160.8	55.642	12.39	538	29528.1	56.709	23.33
419	22893.9	55.187	3.52	479	26216.5	55.655	12.56	539	29584.8	56.733	23.51
420	22949.1	55.190	3.64	480	26272.1	55.667	12.73	540	29641.5	56.756	23.70

TABLE 6.3.2. *Type J thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	29641.5	56.756	23.70	600	33096.0	58.496	33.83	660	36670.8	60.715	38.84
541	29698.3	56.780	23.88	601	33154.5	58.529	33.97	661	36731.6	60.754	38.85
542	29755.1	56.804	24.07	602	33213.1	58.564	34.11	662	36792.3	60.793	38.85
543	29811.9	56.828	24.25	603	33271.7	58.598	34.25	663	36853.1	60.831	38.85
544	29868.8	56.853	24.44	604	33330.3	58.632	34.38	664	36914.0	60.870	38.85
545	29925.6	56.877	24.62	605	33388.9	58.666	34.52	665	36974.9	60.909	38.84
546	29982.5	56.902	24.81	606	33447.6	58.701	34.65	666	37035.8	60.948	38.83
547	30039.4	56.927	24.99	607	33506.3	58.736	34.78	667	37096.8	60.987	38.82
548	30096.4	56.952	25.17	608	33565.1	58.771	34.91	668	37157.8	61.026	38.81
549	30153.3	56.977	25.36	609	33623.9	58.806	35.04	669	37218.8	61.064	38.79
550	30210.3	57.003	25.54	610	33682.7	58.841	35.16	670	37279.9	61.103	38.77
551	30267.3	57.028	25.72	611	33741.6	58.876	35.29	671	37341.0	61.142	38.74
552	30324.4	57.054	25.90	612	33800.5	58.911	35.41	672	37402.2	61.181	38.71
553	30381.4	57.080	26.08	613	33859.4	58.947	35.53	673	37463.4	61.219	38.68
554	30438.5	57.106	26.27	614	33918.4	58.982	35.65	674	37524.6	61.258	38.64
555	30495.7	57.133	26.45	615	33977.4	59.018	35.77	675	37585.9	61.297	38.60
556	30552.8	57.159	26.63	616	34036.4	59.054	35.89	676	37647.2	61.335	38.56
557	30610.0	57.186	26.81	617	34095.5	59.090	36.00	677	37708.6	61.374	38.51
558	30667.2	57.213	26.99	618	34154.6	59.126	36.11	678	37770.0	61.412	38.46
559	30724.4	57.240	27.16	619	34213.7	59.162	36.23	679	37831.4	61.451	38.41
560	30781.6	57.267	27.34	620	34272.9	59.198	36.33	680	37892.9	61.489	38.35
561	30838.9	57.295	27.52	621	34332.1	59.235	36.44	681	37954.4	61.527	38.29
562	30896.2	57.322	27.70	622	34391.4	59.271	36.55	682	38015.9	61.566	38.22
563	30953.6	57.350	27.88	623	34450.6	59.308	36.65	683	38077.5	61.604	38.15
564	31010.9	57.378	28.05	624	34510.0	59.345	36.75	684	38139.1	61.642	38.08
565	31068.3	57.406	28.23	625	34569.3	59.381	36.85	685	38200.8	61.680	38.00
566	31125.7	57.434	28.40	626	34628.7	59.418	36.95	686	38262.5	61.718	37.92
567	31183.2	57.463	28.58	627	34688.2	59.455	37.04	687	38324.2	61.756	37.83
568	31240.7	57.492	28.75	628	34747.6	59.492	37.14	688	38386.0	61.794	37.74
569	31298.2	57.520	28.92	629	34807.2	59.529	37.23	689	38447.8	61.831	37.65
570	31355.7	57.549	29.09	630	34866.7	59.567	37.32	690	38509.7	61.869	37.55
571	31413.3	57.579	29.27	631	34926.3	59.604	37.40	691	38571.6	61.906	37.45
572	31470.9	57.608	29.44	632	34985.9	59.642	37.49	692	38633.5	61.944	37.34
573	31528.5	57.637	29.61	633	35045.6	59.679	37.57	693	38695.4	61.981	37.23
574	31586.1	57.667	29.78	634	35105.3	59.717	37.65	694	38757.4	62.018	37.11
575	31643.8	57.697	29.94	635	35165.0	59.754	37.73	695	38819.5	62.055	36.99
576	31701.5	57.727	30.11	636	35224.8	59.792	37.80	696	38881.6	62.092	36.87
577	31759.3	57.757	30.28	637	35284.6	59.830	37.88	697	38943.7	62.129	36.74
578	31817.1	57.788	30.44	638	35344.4	59.868	37.95	698	39005.8	62.166	36.61
579	31874.9	57.818	30.61	639	35404.3	59.906	38.01	699	39068.0	62.202	36.47
580	31932.7	57.849	30.77	640	35464.3	59.944	38.08	700	39130.2	62.239	36.33
581	31990.6	57.880	30.94	641	35524.2	59.982	38.14	701	39192.5	62.275	36.18
582	32048.5	57.911	31.10	642	35584.2	60.020	38.20	702	39254.8	62.311	36.03
583	32106.4	57.942	31.26	643	35644.3	60.058	38.26	703	39317.1	62.347	35.87
584	32164.3	57.973	31.42	644	35704.3	60.097	38.32	704	39379.5	62.383	35.71
585	32222.3	58.005	31.58	645	35764.5	60.135	38.37	705	39441.9	62.418	35.55
586	32280.3	58.036	31.74	646	35824.6	60.173	38.42	706	39504.3	62.454	35.38
587	32338.4	58.068	31.89	647	35884.8	60.212	38.47	707	39566.8	62.489	35.20
588	32396.5	58.100	32.05	648	35945.0	60.250	38.52	708	39629.3	62.524	35.02
589	32454.6	58.132	32.21	649	36005.3	60.289	38.56	709	39691.8	62.559	34.84
590	32512.7	58.165	32.36	650	36065.6	60.328	38.60	710	39754.4	62.594	34.65
591	32570.9	58.197	32.51	651	36126.0	60.366	38.64	711	39817.0	62.629	34.45
592	32629.1	58.230	32.66	652	36186.3	60.405	38.67	712	39879.7	62.663	34.25
593	32687.4	58.262	32.81	653	36246.8	60.443	38.70	713	39942.3	62.697	34.04
594	32745.7	58.295	32.96	654	36307.2	60.482	38.73	714	40005.0	62.731	33.83
595	32804.0	58.328	33.11	655	36367.7	60.521	38.75	715	40067.8	62.765	33.62
596	32862.3	58.361	33.26	656	36428.3	60.560	38.78	716	40130.6	62.798	33.40
597	32920.7	58.395	33.40	657	36488.8	60.598	38.80	717	40193.4	62.832	33.17
598	32979.1	58.428	33.55	658	36549.5	60.637	38.81	718	40256.2	62.865	32.94
599	33037.6	58.462	33.69	659	36610.1	60.676	38.83	719	40319.1	62.897	32.70
600	33096.0	58.496	33.83	660	36670.8	60.715	38.84	720	40382.0	62.930	32.46

TABLE 6.3.2. *Type J thermocouples—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0°C —Continued*

T $^{\circ}\text{C}$	E μV	S $\mu\text{V}/^{\circ}\text{C}$	dS/dT $\text{nV}/^{\circ}\text{C}^2$	T $^{\circ}\text{C}$	E μV	S $\mu\text{V}/^{\circ}\text{C}$	dS/dT $\text{nV}/^{\circ}\text{C}^2$	T $^{\circ}\text{C}$	E μV	S $\mu\text{V}/^{\circ}\text{C}$	dS/dT $\text{nV}/^{\circ}\text{C}^2$
720	40382.0	62.930	32.46	735	41329.5	63.386	28.13	750	42283.2	63.767	22.41
721	40445.0	62.962	32.21	736	41392.9	63.414	27.80	751	42347.0	63.789	21.98
722	40508.0	62.994	31.96	737	41456.3	63.442	27.45	752	42410.8	63.811	21.53
723	40571.0	63.026	31.70	738	41519.8	63.469	27.11	753	42474.6	63.832	21.08
724	40634.0	63.058	31.43	739	41583.3	63.496	26.75	754	42538.5	63.853	20.63
725	40697.1	63.089	31.16	740	41646.8	63.522	26.39	755	42602.3	63.873	20.16
726	40760.2	63.120	30.88	741	41710.3	63.549	26.02	756	42666.2	63.893	19.69
727	40823.3	63.151	30.60	742	41773.9	63.574	25.65	757	42730.1	63.913	19.22
728	40886.5	63.181	30.31	743	41837.4	63.600	25.27	758	42794.1	63.932	18.73
729	40949.7	63.211	30.02	744	41901.1	63.625	24.88	759	42858.0	63.950	18.24
730	41012.9	63.241	29.72	745	41964.7	63.650	24.48	760	42922.0	63.968	17.74
731	41076.2	63.271	29.42	746	42028.4	63.674	24.08				
732	41139.5	63.300	29.10	747	42092.0	63.698	23.68				
733	41202.8	63.329	28.79	748	42155.8	63.721	23.26				
734	41266.1	63.358	28.46	749	42219.5	63.744	22.84				
735	41329.5	63.386	28.13	750	42283.2	63.767	22.41				

TABLE 6.3.2. *Type J thermocouples extended range—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
				800	45498	64.616	-0.05	850	48716	63.904	-25.38
				801	45562	64.616	-0.74	851	48780	63.878	-25.71
				802	45627	64.615	-1.43	852	48844	63.852	-26.03
				803	45692	64.613	-2.11	853	48908	63.826	-26.34
				804	45756	64.610	-2.78	854	48971	63.800	-26.65
				805	45821	64.607	-3.44	855	49035	63.773	-26.96
				806	45885	64.603	-4.09	856	49099	63.746	-27.25
				807	45950	64.599	-4.74	857	49163	63.718	-27.54
				808	46015	64.594	-5.37	858	49226	63.691	-27.82
				809	46079	64.588	-6.00	859	49290	63.663	-28.10
				810	46144	64.582	-6.62	860	49354	63.634	-28.37
				811	46208	64.575	-7.24	861	49417	63.606	-28.64
				812	46273	64.567	-7.84	862	49481	63.577	-28.90
				813	46337	64.559	-8.44	863	49544	63.548	-29.15
				814	46402	64.551	-9.03	864	49608	63.519	-29.40
				815	46467	64.541	-9.61	865	49671	63.489	-29.64
				816	46531	64.531	-10.19	866	49735	63.459	-29.88
				817	46596	64.521	-10.75	867	49798	63.429	-30.11
				818	46660	64.510	-11.31	868	49862	63.399	-30.33
				819	46725	64.498	-11.86	869	49925	63.369	-30.55
				820	46789	64.486	-12.41	870	49989	63.338	-30.76
				821	46854	64.473	-12.94	871	50052	63.307	-30.97
				822	46918	64.460	-13.47	872	50115	63.276	-31.17
				823	46983	64.447	-13.99	873	50178	63.245	-31.37
				824	47047	64.432	-14.51	874	50242	63.213	-31.56
				825	47111	64.418	-15.01	875	50305	63.182	-31.74
				826	47176	64.402	-15.51	876	50368	63.150	-31.92
				827	47240	64.386	-16.00	877	50431	63.118	-32.09
				828	47305	64.370	-16.49	878	50494	63.086	-32.26
				829	47369	64.354	-16.97	879	50557	63.053	-32.42
				830	47433	64.336	-17.44	880	50620	63.021	-32.58
				831	47498	64.319	-17.90	881	50683	62.988	-32.73
				832	47562	64.301	-18.35	882	50746	62.956	-32.88
				833	47626	64.282	-18.80	883	50809	62.923	-33.02
				834	47691	64.263	-19.25	884	50872	62.889	-33.16
				835	47755	64.243	-19.68	885	50935	62.856	-33.29
				836	47819	64.224	-20.11	886	50998	62.823	-33.42
				837	47883	64.203	-20.53	887	51061	62.789	-33.54
				838	47947	64.183	-20.94	888	51123	62.756	-33.66
				839	48012	64.161	-21.35	889	51186	62.722	-33.77
				840	48076	64.140	-21.75	890	51249	62.688	-33.87
				841	48140	64.118	-22.14	891	51312	62.654	-33.98
				842	48204	64.096	-22.53	892	51374	62.620	-34.07
				843	48268	64.073	-22.91	893	51437	62.586	-34.16
				844	48332	64.050	-23.28	894	51499	62.552	-34.25
				845	48396	64.026	-23.65	895	51562	62.518	-34.33
				846	48460	64.002	-24.01	896	51624	62.483	-34.41
				847	48524	63.978	-24.36	897	51687	62.449	-34.48
				848	48588	63.954	-24.71	898	51749	62.414	-34.55
				849	48652	63.929	-25.05	899	51812	62.380	-34.62
				850	48716	63.904	-25.38	900	51874	62.345	-34.67

TABLE 6.3.2. *Type J thermocouples extended range—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	51874	62.345	-34.67	960	55553	60.306	-31.25	1020	59121	58.760	-19.58
901	51936	62.310	-34.73	961	55613	60.275	-31.10	1021	59180	58.740	-19.36
902	51999	62.276	-34.78	962	55673	60.244	-30.95	1022	59238	58.721	-19.15
903	52061	62.241	-34.82	963	55733	60.213	-30.80	1023	59297	58.702	-18.93
904	52123	62.206	-34.87	964	55794	60.182	-30.64	1024	59356	58.683	-18.71
905	52185	62.171	-34.90	965	55854	60.151	-30.48	1025	59415	58.665	-18.49
906	52248	62.136	-34.93	966	55914	60.121	-30.32	1026	59473	58.646	-18.27
907	52310	62.101	-34.96	967	55974	60.091	-30.16	1027	59532	58.628	-18.06
908	52372	62.066	-34.99	968	56034	60.061	-30.00	1028	59590	58.610	-17.84
909	52434	62.031	-35.01	969	56094	60.031	-29.83	1029	59649	58.592	-17.62
910	52496	61.996	-35.02	970	56154	60.001	-29.66	1030	59708	58.575	-17.40
911	52558	61.961	-35.03	971	56214	59.971	-29.49	1031	59766	58.558	-17.19
912	52620	61.926	-35.04	972	56274	59.942	-29.32	1032	59825	58.540	-16.97
913	52682	61.891	-35.04	973	56334	59.913	-29.15	1033	59883	58.524	-16.75
914	52744	61.856	-35.04	974	56394	59.884	-28.97	1034	59942	58.507	-16.54
915	52805	61.821	-35.04	975	56454	59.855	-28.79	1035	60000	58.490	-16.32
916	52867	61.786	-35.03	976	56514	59.826	-28.61	1036	60059	58.474	-16.11
917	52929	61.751	-35.01	977	56573	59.798	-28.43	1037	60117	58.458	-15.90
918	52991	61.716	-35.00	978	56633	59.769	-28.25	1038	60176	58.442	-15.68
919	53052	61.681	-34.98	979	56693	59.741	-28.07	1039	60234	58.427	-15.47
920	53114	61.646	-34.95	980	56753	59.713	-27.88	1040	60293	58.412	-15.26
921	53176	61.611	-34.92	981	56812	59.685	-27.69	1041	60351	58.396	-15.05
922	53237	61.576	-34.89	982	56872	59.658	-27.50	1042	60409	58.381	-14.84
923	53299	61.541	-34.85	983	56932	59.630	-27.31	1043	60468	58.367	-14.63
924	53360	61.507	-34.81	984	56991	59.603	-27.12	1044	60526	58.352	-14.42
925	53422	61.472	-34.77	985	57051	59.576	-26.93	1045	60584	58.338	-14.21
926	53483	61.437	-34.72	986	57110	59.549	-26.73	1046	60643	58.324	-14.00
927	53545	61.402	-34.67	987	57170	59.523	-26.54	1047	60701	58.310	-13.80
928	53606	61.368	-34.62	988	57229	59.496	-26.34	1048	60759	58.296	-13.59
929	53667	61.333	-34.56	989	57289	59.470	-26.14	1049	60818	58.283	-13.39
930	53729	61.299	-34.50	990	57348	59.444	-25.94	1050	60876	58.269	-13.18
931	53790	61.264	-34.44	991	57408	59.418	-25.74	1051	60934	58.256	-12.98
932	53851	61.230	-34.37	992	57467	59.392	-25.54	1052	60992	58.243	-12.78
933	53912	61.195	-34.30	993	57527	59.367	-25.34	1053	61051	58.231	-12.58
934	53974	61.161	-34.22	994	57586	59.342	-25.13	1054	61109	58.218	-12.38
935	54035	61.127	-34.15	995	57645	59.317	-24.93	1055	61167	58.206	-12.18
936	54096	61.093	-34.07	996	57705	59.292	-24.72	1056	61225	58.194	-11.99
937	54157	61.059	-33.98	997	57764	59.267	-24.52	1057	61284	58.182	-11.79
938	54218	61.025	-33.89	998	57823	59.243	-24.31	1058	61342	58.170	-11.60
939	54279	60.991	-33.80	999	57882	59.219	-24.10	1059	61400	58.159	-11.41
940	54340	60.957	-33.71	1000	57942	59.195	-23.89	1060	61458	58.148	-11.22
941	54401	60.924	-33.61	1001	58001	59.171	-23.68	1061	61516	58.136	-11.03
942	54462	60.890	-33.51	1002	58060	59.147	-23.47	1062	61574	58.125	-10.84
943	54523	60.857	-33.41	1003	58119	59.124	-23.26	1063	61632	58.115	-10.65
944	54584	60.823	-33.31	1004	58178	59.101	-23.04	1064	61691	58.104	-10.47
945	54644	60.790	-33.20	1005	58237	59.078	-22.83	1065	61749	58.094	-10.29
946	54705	60.757	-33.09	1006	58296	59.055	-22.62	1066	61807	58.084	-10.10
947	54766	60.724	-32.97	1007	58355	59.033	-22.40	1067	61865	58.074	-9.92
948	54827	60.691	-32.86	1008	58414	59.010	-22.19	1068	61923	58.064	-9.75
949	54887	60.658	-32.74	1009	58473	58.988	-21.97	1069	61981	58.054	-9.57
950	54948	60.625	-32.62	1010	58532	58.966	-21.76	1070	62039	58.045	-9.40
951	55009	60.593	-32.49	1011	58591	58.945	-21.54	1071	62097	58.035	-9.22
952	55069	60.560	-32.36	1012	58650	58.923	-21.32	1072	62155	58.026	-9.05
953	55130	60.528	-32.23	1013	58709	58.902	-21.11	1073	62213	58.017	-8.88
954	55190	60.496	-32.10	1014	58768	58.881	-20.89	1074	62271	58.008	-8.72
955	55251	60.464	-31.97	1015	58827	58.860	-20.67	1075	62329	58.000	-8.55
956	55311	60.432	-31.83	1016	58886	58.840	-20.45	1076	62387	57.991	-8.39
957	55372	60.400	-31.69	1017	58945	58.819	-20.24	1077	62445	57.983	-8.23
958	55432	60.369	-31.55	1018	59003	58.799	-20.02	1078	62503	57.975	-8.07
959	55492	60.337	-31.40	1019	59062	58.779	-19.80	1079	62561	57.967	-7.91
960	55553	60.306	-31.25	1020	59121	58.760	-19.58	1080	62619	57.959	-7.76

TABLE 6.3.2. *Type J thermocouples extended range—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1080	62619	57.959	-7.76	1120	64932	57.744	-3.79	1160	67239	57.577	-5.75
1081	62677	57.951	-7.61	1121	64990	57.740	-3.76	1161	67297	57.571	-5.90
1082	62735	57.944	-7.46	1122	65048	57.736	-3.73	1162	67354	57.565	-6.05
1083	62793	57.936	-7.31	1123	65106	57.733	-3.70	1163	67412	57.559	-6.20
1084	62851	57.929	-7.16	1124	65163	57.729	-3.68	1164	67469	57.553	-6.37
1085	62909	57.922	-7.02	1125	65221	57.725	-3.66	1165	67527	57.546	-6.53
1086	62967	57.915	-6.88	1126	65279	57.722	-3.65	1166	67585	57.539	-6.71
1087	63024	57.908	-6.74	1127	65337	57.718	-3.64	1167	67642	57.533	-6.88
1088	63082	57.902	-6.61	1128	65394	57.714	-3.63	1168	67700	57.526	-7.07
1089	63140	57.895	-6.47	1129	65452	57.711	-3.63	1169	67757	57.519	-7.25
1090	63198	57.889	-6.34	1130	65510	57.707	-3.63	1170	67815	57.511	-7.45
1091	63256	57.882	-6.21	1131	65567	57.703	-3.64	1171	67872	57.504	-7.65
1092	63314	57.876	-6.09	1132	65625	57.700	-3.65	1172	67930	57.496	-7.85
1093	63372	57.870	-5.97	1133	65683	57.696	-3.66	1173	67987	57.488	-8.07
1094	63430	57.864	-5.84	1134	65741	57.692	-3.68	1174	68045	57.480	-8.28
1095	63488	57.859	-5.73	1135	65798	57.689	-3.70	1175	68102	57.471	-8.51
1096	63545	57.853	-5.61	1136	65856	57.685	-3.73	1176	68160	57.463	-8.73
1097	63603	57.847	-5.50	1137	65914	57.681	-3.76	1177	68217	57.454	-8.97
1098	63661	57.842	-5.39	1138	65971	57.677	-3.79	1178	68274	57.445	-9.21
1099	63719	57.837	-5.29	1139	66029	57.674	-3.83	1179	68332	57.435	-9.45
1100	63777	57.831	-5.18	1140	66087	57.670	-3.88	1180	68389	57.426	-9.71
1101	63835	57.826	-5.08	1141	66144	57.666	-3.93	1181	68447	57.416	-9.96
1102	63892	57.821	-4.99	1142	66202	57.662	-3.98	1182	68504	57.406	-10.23
1103	63950	57.816	-4.89	1143	66260	57.658	-4.04	1183	68562	57.396	-10.50
1104	64008	57.811	-4.80	1144	66317	57.654	-4.10	1184	68619	57.385	-10.77
1105	64066	57.807	-4.71	1145	66375	57.650	-4.17	1185	68676	57.374	-11.05
1106	64124	57.802	-4.63	1146	66433	57.646	-4.24	1186	68734	57.363	-11.34
1107	64181	57.797	-4.55	1147	66490	57.641	-4.32	1187	68791	57.351	-11.64
1108	64239	57.793	-4.47	1148	66548	57.637	-4.40	1188	68848	57.340	-11.94
1109	64297	57.788	-4.39	1149	66605	57.632	-4.48	1189	68906	57.327	-12.24
1110	64355	57.784	-4.32	1150	66663	57.628	-4.57	1190	68963	57.315	-12.56
1111	64413	57.780	-4.25	1151	66721	57.623	-4.67	1191	69020	57.302	-12.88
1112	64470	57.776	-4.19	1152	66778	57.619	-4.77	1192	69078	57.289	-13.20
1113	64528	57.771	-4.12	1153	66836	57.614	-4.87	1193	69135	57.276	-13.53
1114	64586	57.767	-4.07	1154	66894	57.609	-4.98	1194	69192	57.262	-13.87
1115	64644	57.763	-4.01	1155	66951	57.604	-5.10	1195	69249	57.248	-14.22
1116	64701	57.759	-3.96	1156	67009	57.599	-5.22	1196	69307	57.234	-14.57
1117	64759	57.755	-3.91	1157	67066	57.593	-5.34	1197	69364	57.219	-14.93
1118	64817	57.751	-3.87	1158	67124	57.588	-5.48	1198	69421	57.204	-15.29
1119	64875	57.748	-3.83	1159	67182	57.582	-5.61	1199	69478	57.188	-15.66
1120	64932	57.744	-3.79	1160	67239	57.577	-5.75	1200	69536	57.173	-16.04

TABLE 6.3.3. *Thermoelectric values at the fixed points for Type J thermocouples*

Fixed point	Temp. °C	E μV	S μV/°C	dS/dT nV/°C ²
Nitrogen TP	-210.002	-8095.7	19.126	283.95
Nitrogen NBP	-195.802	-7796.3	22.972	258.19
Oxygen NBP	-182.962	-7480.7	26.148	236.73
Carbon Dioxide SP	-78.476	-3718.7	43.721	112.93
Mercury FP	-38.862	-1906.3	47.586	83.46
Ice point	0.000	0.0	50.373	60.85
Ether TP	26.870	1373.9	51.832	48.13
Water BP	100.000	5267.7	54.348	22.61
Benzoic TP	122.370	6488.6	54.788	16.89
Indium FP	156.634	8374.3	55.238	9.68
Tin FP	231.9681	12551.7	55.537	-0.54
Bismuth FP	271.442	14742.7	55.459	-3.08
Cadmium FP	321.108	17492.8	55.280	-3.65
Lead FP	327.502	17846.2	55.257	-3.51
Mercury BP	356.660	19456.0	55.170	-2.28
Zinc FP	419.580	22925.9	55.189	3.59
Sulphur BP	444.674	24312.3	55.321	7.03
Cu-Al FP	548.23	30109.5	56.985	25.21
Antimony FP	630.74	34910.8	59.594	37.38
Aluminum FP	660.37	36693.3	60.729	38.84
Silver FP	961.93	55669	60.246	-30.96
Gold FP	1064.43	61716	58.100	-10.39
Copper FP	1084.5	62880	57.926	-7.09

TABLE 6.3.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type J thermocouples*

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-210 to -100 °C	7	3	0.2	<0.1	<0.1	<0.1
-100 to 0 °C	7	2	0.1	<0.1	<0.1	<0.1
0 to 200 °C	7	4	0.2	<0.1	<0.1	<0.1
200 to 400 °C	7	12	0.3	<0.1	<0.1	<0.1
400 to 600 °C	7	40	0.7	<0.1	<0.1	<0.1
600 to 760 °C	7	80	2	<0.1	<0.1	<0.1
760 to 1000 °C	5	(*)	60	0.3	<1.0	<1.0
1000 to 1200 °C	5	(*)	90	0.3	<1.0	<1.0

*A high-order polynomial with a low-bit machine causes extreme error.

6.4. Reference Functions and Tables for the Positive Thermoelement, Type JP, Iron Versus Platinum, Pt-67

The coefficients for the seventh degree expansion for the thermoelectric voltage of Type JP thermoelements versus Pt-67 below 760 °C are given in table 6.4.1. The errors caused by using reduced bit arithmetic for calculating values of the functions are given in table 6.4.4.

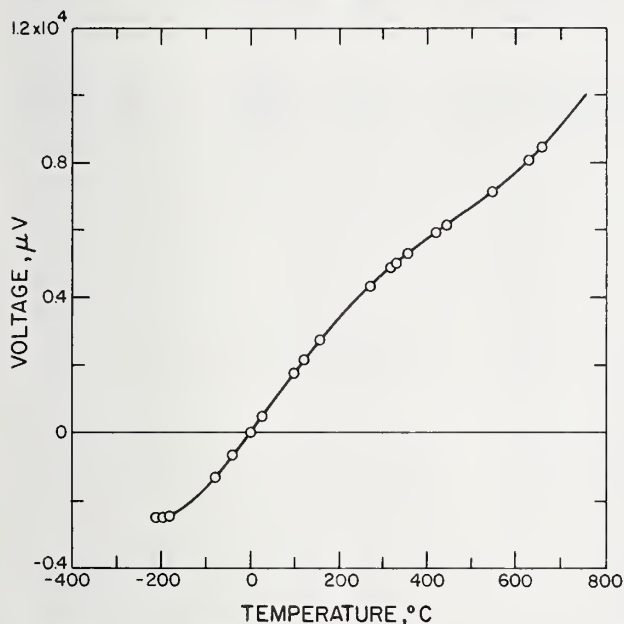


FIGURE 6.4.1. Thermoelectric voltage for Type JP thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

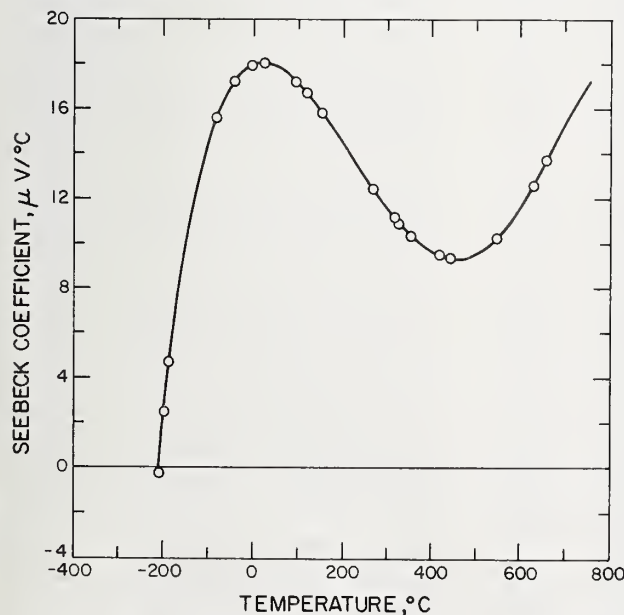


FIGURE 6.4.2. Seebeck coefficient for Type JP thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

The primary reference values for Type JP thermoelements versus Pt-67 are given in table 6.4.2. Values at selected fixed points are given in table 6.4.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 6.4.1, 6.4.2, and 6.4.3, respectively.

Because of the lack of stability of Type J thermocouples above 760 °C, no reference functions are given for Type JP above 760 °C.

The tables in this section merely give average values for industrial materials which have a wide variability. The tables in this section do NOT contain standardized values. Neither the ASTM nor the ISA recognize Type JP or JN thermoelements as standardized materials.

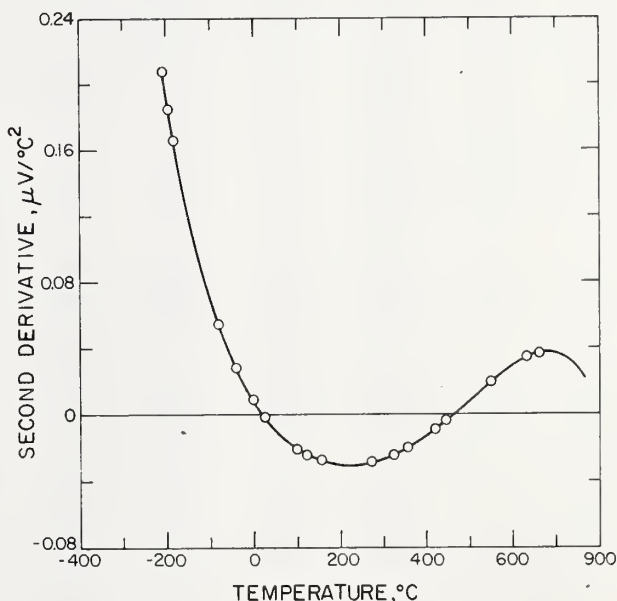


FIGURE 6.4.3. Second derivative of thermoelectric voltage for Type JP thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 6.4.1. Power series expansion for the thermoelectric voltage of Type JP thermoelements versus platinum, Pt-67

Temperature range	Degree	Coefficients	Term
-210 to 760 °C	7	1.7910320204×10^1	T
		$4.6647761097 \times 10^{-3}$	T^2
		$-7.1172460609 \times 10^{-5}$	T^3
		$1.3372217238 \times 10^{-7}$	T^4
		$-1.5045762690 \times 10^{-10}$	T^5
		$1.5339015011 \times 10^{-13}$	T^6
		$-7.5257947432 \times 10^{-17}$	T^7

TABLE 6.4.2. *Type JP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-210	-2560.3	-0.303	207.88	-200	-2553.2	1.693	191.37	-190	-2527.0	3.528	175.81
-209	-2560.5	-0.096	206.19	-199	-2551.4	1.883	189.77	-189	-2523.4	3.703	174.31
-208	-2560.5	0.110	204.50	-198	-2549.4	2.072	188.18	-188	-2519.6	3.876	172.81
-207	-2560.3	0.313	202.82	-197	-2547.3	2.260	186.61	-187	-2515.6	4.049	171.33
-206	-2559.9	0.515	201.16	-196	-2544.9	2.445	185.04	-186	-2511.5	4.219	169.85
-205	-2559.2	0.716	199.50	-195	-2542.4	2.630	183.48	-185	-2507.2	4.388	168.38
-204	-2558.4	0.914	197.86	-194	-2539.7	2.812	181.93	-184	-2502.7	4.556	166.92
-203	-2557.4	1.111	196.22	-193	-2536.8	2.994	180.38	-183	-2498.1	4.722	165.47
-202	-2556.2	1.307	194.59	-192	-2533.7	3.173	178.85	-182	-2493.3	4.887	164.02
-201	-2554.8	1.501	192.98	-191	-2530.4	3.351	177.33	-181	-2488.3	5.050	162.59
-200	-2553.2	1.693	191.37	-190	-2527.0	3.528	175.81	-180	-2483.2	5.212	161.16

TABLE 6.4.2. *Type JP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-180	-2483.2	5.212	161.16	-120	-1927.1	12.611	89.91	-60	-1040.6	16.456	41.44
-179	-2477.9	5.372	159.75	-119	-1914.5	12.701	88.94	-59	-1024.1	16.497	40.79
-178	-2472.4	5.532	158.34	-118	-1901.7	12.789	87.97	-58	-1007.6	16.537	40.14
-177	-2466.8	5.689	156.94	-117	-1888.9	12.877	87.01	-57	-991.0	16.577	39.49
-176	-2461.0	5.845	155.55	-116	-1876.0	12.963	86.05	-56	-974.4	16.616	38.85
-175	-2455.1	6.000	154.17	-115	-1863.0	13.049	85.11	-55	-957.8	16.655	38.21
-174	-2449.0	6.154	152.79	-114	-1849.9	13.133	84.16	-54	-941.1	16.693	37.58
-173	-2442.8	6.306	151.42	-113	-1836.7	13.217	83.22	-53	-924.4	16.730	36.96
-172	-2436.4	6.457	150.07	-112	-1823.4	13.300	82.29	-52	-907.7	16.767	36.33
-171	-2429.9	6.606	148.72	-111	-1810.1	13.382	81.37	-51	-890.9	16.803	35.71
-170	-2423.2	6.754	147.38	-110	-1796.7	13.463	80.45	-50	-874.1	16.838	35.10
-169	-2416.4	6.901	146.04	-109	-1783.2	13.543	79.54	-49	-857.2	16.873	34.49
-168	-2409.4	7.046	144.72	-108	-1769.6	13.622	78.63	-48	-840.3	16.907	33.88
-167	-2402.3	7.190	143.40	-107	-1755.9	13.700	77.73	-47	-823.4	16.941	33.28
-166	-2395.0	7.333	142.09	-106	-1742.2	13.777	76.83	-46	-806.4	16.974	32.68
-165	-2387.6	7.474	140.79	-105	-1728.4	13.854	75.94	-45	-789.5	17.006	32.09
-164	-2380.1	7.615	139.50	-104	-1714.5	13.929	75.06	-44	-772.4	17.038	31.50
-163	-2372.4	7.753	138.21	-103	-1700.5	14.004	74.18	-43	-755.4	17.069	30.91
-162	-2364.6	7.891	136.94	-102	-1686.5	14.077	73.31	-42	-738.3	17.100	30.33
-161	-2356.6	8.027	135.67	-101	-1672.4	14.150	72.44	-41	-721.2	17.130	29.76
-160	-2348.5	8.162	134.41	-100	-1658.2	14.222	71.58	-40	-704.0	17.159	29.18
-159	-2340.3	8.296	133.15	-99	-1643.9	14.293	70.73	-39	-686.9	17.188	28.61
-158	-2331.9	8.429	131.91	-98	-1629.6	14.364	69.88	-38	-669.7	17.216	28.05
-157	-2323.4	8.560	130.67	-97	-1615.2	14.433	69.03	-37	-652.4	17.244	27.49
-156	-2314.8	8.690	129.44	-96	-1600.7	14.502	68.19	-36	-635.2	17.271	26.93
-155	-2306.1	8.819	128.22	-95	-1586.2	14.570	67.36	-35	-617.9	17.298	26.38
-154	-2297.2	8.946	127.00	-94	-1571.6	14.637	66.53	-34	-600.6	17.324	25.83
-153	-2288.2	9.073	125.79	-93	-1556.9	14.703	65.71	-33	-583.2	17.350	25.28
-152	-2279.0	9.198	124.59	-92	-1542.2	14.768	64.89	-32	-565.9	17.375	24.74
-151	-2269.8	9.322	123.40	-91	-1527.4	14.832	64.08	-31	-548.5	17.399	24.20
-150	-2260.4	9.445	122.22	-90	-1512.5	14.896	63.27	-30	-531.1	17.423	23.67
-149	-2250.9	9.566	121.04	-89	-1497.6	14.959	62.47	-29	-513.6	17.447	23.14
-148	-2241.3	9.687	119.87	-88	-1482.6	15.021	61.68	-28	-496.2	17.469	22.61
-147	-2231.5	9.806	118.70	-87	-1467.5	15.082	60.89	-27	-478.7	17.492	22.09
-146	-2221.6	9.924	117.55	-86	-1452.4	15.143	60.10	-26	-461.2	17.514	21.57
-145	-2211.7	10.041	116.40	-85	-1437.3	15.203	59.32	-25	-443.7	17.535	21.06
-144	-2201.6	10.157	115.26	-84	-1422.0	15.262	58.55	-24	-426.1	17.556	20.55
-143	-2191.3	10.272	114.12	-83	-1406.7	15.320	57.78	-23	-408.6	17.576	20.04
-142	-2181.0	10.385	112.99	-82	-1391.4	15.377	57.02	-22	-391.0	17.596	19.53
-141	-2170.6	10.498	111.87	-81	-1376.0	15.434	56.26	-21	-373.4	17.615	19.03
-140	-2160.0	10.609	110.76	-80	-1360.5	15.490	55.50	-20	-355.7	17.634	18.54
-139	-2149.4	10.719	109.65	-79	-1345.0	15.545	54.75	-19	-338.1	17.652	18.04
-138	-2138.6	10.828	108.55	-78	-1329.4	15.599	54.01	-18	-320.4	17.670	17.55
-137	-2127.7	10.936	107.46	-77	-1313.8	15.653	53.27	-17	-302.8	17.687	17.07
-136	-2116.7	11.043	106.38	-76	-1298.1	15.706	52.54	-16	-285.1	17.704	16.59
-135	-2105.6	11.149	105.30	-75	-1282.4	15.758	51.81	-15	-267.4	17.720	16.11
-134	-2094.4	11.254	104.23	-74	-1266.6	15.809	51.08	-14	-249.6	17.736	15.63
-133	-2083.1	11.358	103.16	-73	-1250.8	15.860	50.36	-13	-231.9	17.752	15.16
-132	-2071.7	11.460	102.10	-72	-1234.9	15.910	49.65	-12	-214.1	17.767	14.69
-131	-2060.2	11.562	101.05	-71	-1219.0	15.959	48.94	-11	-196.4	17.781	14.23
-130	-2048.6	11.662	100.01	-70	-1203.0	16.008	48.23	-10	-178.6	17.795	13.76
-129	-2036.9	11.762	98.97	-69	-1186.9	16.056	47.53	-9	-160.8	17.809	13.31
-128	-2025.1	11.860	97.94	-68	-1170.9	16.103	46.84	-8	-142.9	17.822	12.85
-127	-2013.1	11.958	96.91	-67	-1154.7	16.149	46.15	-7	-125.1	17.834	12.40
-126	-2001.1	12.054	95.89	-66	-1138.6	16.195	45.46	-6	-107.3	17.847	11.95
-125	-1989.0	12.149	94.88	-65	-1122.3	16.240	44.78	-5	-89.4	17.858	11.51
-124	-1976.8	12.244	93.87	-64	-1106.1	16.285	44.10	-4	-71.6	17.870	11.06
-123	-1964.5	12.337	92.87	-63	-1089.8	16.329	43.43	-3	-53.7	17.880	10.63
-122	-1952.2	12.430	91.88	-62	-1073.4	16.372	42.76	-2	-35.8	17.891	10.19
-121	-1939.7	12.521	90.89	-61	-1057.0	16.414	42.10	-1	-17.9	17.901	9.76
-120	-1927.1	12.611	89.91	-60	-1040.6	16.456	41.44	0	0.0	17.910	9.33

TABLE 6.4.2. *Type JP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.0	17.910	9.33	60	1077.7	17.808	-11.11	120	2117.8	16.745	-23.13
1	17.9	17.919	8.90	61	1095.5	17.797	-11.37	121	2134.6	16.722	-23.47
2	35.8	17.928	8.48	62	1113.3	17.785	-11.63	122	2151.3	16.698	-23.41
3	53.8	17.936	8.06	63	1131.0	17.773	-11.89	123	2168.0	16.675	-23.55
4	71.7	17.944	7.65	64	1148.8	17.761	-12.14	124	2184.6	16.651	-23.69
5	89.7	17.952	7.23	65	1166.6	17.749	-12.40	125	2201.3	16.627	-23.83
6	107.6	17.959	6.82	66	1184.3	17.737	-12.65	126	2217.9	16.604	-23.96
7	125.6	17.965	6.42	67	1202.0	17.724	-12.90	127	2234.5	16.580	-24.09
8	143.5	17.972	6.01	68	1219.7	17.711	-13.14	128	2251.0	16.555	-24.22
9	161.5	17.977	5.61	69	1237.5	17.698	-13.39	129	2267.6	16.531	-24.35
10	179.5	17.983	5.22	70	1255.1	17.684	-13.63	130	2284.1	16.507	-24.48
11	197.5	17.988	4.82	71	1272.8	17.670	-13.87	131	2300.6	16.482	-24.61
12	215.5	17.992	4.43	72	1290.5	17.656	-14.10	132	2317.1	16.457	-24.73
13	233.5	17.997	4.04	73	1308.1	17.642	-14.34	133	2333.5	16.433	-24.85
14	251.5	18.001	3.66	74	1325.8	17.628	-14.57	134	2349.9	16.408	-24.97
15	269.5	18.004	3.28	75	1343.4	17.613	-14.80	135	2366.3	16.383	-25.09
16	287.5	18.007	2.90	76	1361.0	17.598	-15.03	136	2382.7	16.358	-25.21
17	305.5	18.010	2.52	77	1378.6	17.583	-15.26	137	2399.0	16.332	-25.33
18	323.5	18.012	2.15	78	1396.2	17.568	-15.48	138	2415.4	16.307	-25.44
19	341.5	18.014	1.78	79	1413.7	17.552	-15.71	139	2431.7	16.281	-25.55
20	359.5	18.016	1.41	80	1431.3	17.536	-15.93	140	2447.9	16.256	-25.66
21	377.5	18.017	1.04	81	1448.8	17.520	-16.14	141	2464.2	16.230	-25.77
22	395.6	18.018	0.68	82	1466.3	17.504	-16.36	142	2480.4	16.204	-25.88
23	413.6	18.018	0.32	83	1483.8	17.487	-16.57	143	2496.6	16.178	-25.99
24	431.6	18.018	-0.04	84	1501.3	17.471	-16.79	144	2512.7	16.152	-26.09
25	449.6	18.018	-0.39	85	1518.7	17.454	-17.00	145	2528.9	16.126	-26.19
26	467.6	18.018	-0.74	86	1536.2	17.437	-17.20	146	2545.0	16.100	-26.30
27	485.6	18.017	-1.09	87	1553.6	17.419	-17.41	147	2561.1	16.074	-26.40
28	503.7	18.015	-1.43	88	1571.0	17.402	-17.61	148	2577.1	16.047	-26.49
29	521.7	18.014	-1.78	89	1588.4	17.384	-17.82	149	2593.2	16.021	-26.59
30	539.7	18.012	-2.11	90	1605.8	17.366	-18.02	150	2609.2	15.994	-26.69
31	557.7	18.010	-2.45	91	1623.1	17.348	-18.21	151	2625.2	15.967	-26.78
32	575.7	18.007	-2.79	92	1640.5	17.330	-18.41	152	2641.1	15.940	-26.87
33	593.7	18.004	-3.12	93	1657.8	17.311	-18.60	153	2657.0	15.913	-26.96
34	611.7	18.001	-3.45	94	1675.1	17.293	-18.80	154	2672.9	15.886	-27.05
35	629.7	17.997	-3.77	95	1692.4	17.274	-18.99	155	2688.8	15.859	-27.14
36	647.7	17.993	-4.10	96	1709.7	17.255	-19.17	156	2704.7	15.832	-27.23
37	665.7	17.989	-4.42	97	1726.9	17.235	-19.36	157	2720.5	15.805	-27.31
38	683.7	17.984	-4.74	98	1744.1	17.216	-19.54	158	2736.3	15.778	-27.40
39	701.7	17.979	-5.05	99	1761.3	17.196	-19.73	159	2752.0	15.750	-27.48
40	719.6	17.974	-5.37	100	1778.5	17.176	-19.91	160	2767.8	15.723	-27.56
41	737.6	17.969	-5.68	101	1795.7	17.156	-20.09	161	2783.5	15.695	-27.64
42	755.6	17.963	-5.98	102	1812.8	17.136	-20.26	162	2799.2	15.667	-27.71
43	773.5	17.957	-6.29	103	1830.0	17.116	-20.44	163	2814.8	15.640	-27.79
44	791.5	17.950	-6.59	104	1847.1	17.095	-20.61	164	2830.4	15.612	-27.86
45	809.4	17.944	-6.89	105	1864.2	17.075	-20.78	165	2846.0	15.584	-27.94
46	827.4	17.937	-7.19	106	1881.2	17.054	-20.95	166	2861.6	15.556	-28.01
47	845.3	17.929	-7.49	107	1898.3	17.033	-21.12	167	2877.2	15.528	-28.08
48	863.2	17.922	-7.78	108	1915.3	17.012	-21.28	168	2892.7	15.500	-28.15
49	881.2	17.914	-8.07	109	1932.3	16.990	-21.45	169	2908.2	15.471	-28.22
50	899.1	17.905	-8.36	110	1949.3	16.969	-21.61	170	2923.6	15.443	-28.28
51	917.0	17.897	-8.64	111	1966.2	16.947	-21.77	171	2939.0	15.415	-28.35
52	934.9	17.888	-8.93	112	1983.2	16.925	-21.93	172	2954.4	15.387	-28.41
53	952.7	17.879	-9.21	113	2000.1	16.903	-22.09	173	2969.8	15.358	-28.47
54	970.6	17.870	-9.49	114	2017.0	16.881	-22.24	174	2985.2	15.330	-28.53
55	988.5	17.860	-9.76	115	2033.8	16.859	-22.39	175	3000.5	15.301	-28.59
56	1006.3	17.850	-10.04	116	2050.7	16.836	-22.54	176	3015.8	15.272	-28.65
57	1024.2	17.840	-10.31	117	2067.5	16.814	-22.69	177	3031.0	15.244	-28.70
58	1042.0	17.830	-10.58	118	2084.3	16.791	-22.84	178	3046.2	15.215	-28.76
59	1059.8	17.819	-10.84	119	2101.1	16.768	-22.99	179	3061.4	15.186	-28.81
60	1077.7	17.808	-11.11	120	2117.8	16.745	-23.13	180	3076.6	15.157	-28.86

TABLE 6.4.2. *Type JP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	3076.6	15.157	-28.86	240	3933.0	13.381	-29.58	300	4684.2	11.693	-26.02
181	3091.8	15.129	-28.91	241	3946.4	13.352	-29.55	301	4695.9	11.668	-25.92
182	3106.9	15.100	-28.96	242	3959.7	13.322	-29.53	302	4707.5	11.642	-25.83
183	3122.0	15.071	-29.01	243	3973.0	13.293	-29.50	303	4719.1	11.616	-25.73
184	3137.0	15.042	-29.05	244	3986.3	13.263	-29.47	304	4730.7	11.590	-25.64
185	3152.0	15.012	-29.10	245	3999.5	13.234	-29.44	305	4742.3	11.565	-25.54
186	3167.0	14.983	-29.14	246	4012.8	13.204	-29.41	306	4753.9	11.539	-25.44
187	3182.0	14.954	-29.19	247	4025.9	13.175	-29.37	307	4765.4	11.514	-25.34
188	3197.0	14.925	-29.23	248	4039.1	13.146	-29.34	308	4776.9	11.488	-25.24
189	3211.9	14.896	-29.27	249	4052.2	13.116	-29.30	309	4788.4	11.463	-25.14
190	3226.7	14.866	-29.30	250	4065.3	13.087	-29.27	310	4799.8	11.438	-25.04
191	3241.6	14.837	-29.34	251	4078.4	13.058	-29.23	311	4811.2	11.413	-24.94
192	3256.4	14.808	-29.38	252	4091.5	13.029	-29.19	312	4822.6	11.388	-24.83
193	3271.2	14.778	-29.41	253	4104.5	12.999	-29.15	313	4834.0	11.363	-24.73
194	3286.0	14.749	-29.44	254	4117.4	12.970	-29.11	314	4845.4	11.339	-24.62
195	3300.7	14.720	-29.47	255	4130.4	12.941	-29.07	315	4856.7	11.314	-24.51
196	3315.4	14.690	-29.51	256	4143.3	12.912	-29.02	316	4868.0	11.290	-24.41
197	3330.1	14.661	-29.53	257	4156.2	12.883	-28.98	317	4879.3	11.265	-24.30
198	3344.7	14.631	-29.56	258	4169.1	12.854	-28.93	318	4890.5	11.241	-24.19
199	3359.4	14.601	-29.59	259	4181.9	12.825	-28.89	319	4901.8	11.217	-24.07
200	3373.9	14.572	-29.61	260	4194.7	12.796	-28.84	320	4913.0	11.193	-23.96
201	3388.5	14.542	-29.64	261	4207.5	12.768	-28.79	321	4924.1	11.169	-23.85
202	3403.0	14.513	-29.66	262	4220.3	12.739	-28.74	322	4935.3	11.145	-23.73
203	3417.5	14.483	-29.68	263	4233.0	12.710	-28.69	323	4946.4	11.122	-23.62
204	3432.0	14.453	-29.70	264	4245.7	12.681	-28.64	324	4957.5	11.098	-23.50
205	3446.4	14.423	-29.72	265	4258.4	12.653	-28.58	325	4968.6	11.075	-23.38
206	3460.8	14.394	-29.74	266	4271.0	12.624	-28.53	326	4979.7	11.051	-23.27
207	3475.2	14.364	-29.75	267	4283.6	12.596	-28.47	327	4990.7	11.028	-23.15
208	3489.6	14.334	-29.77	268	4296.2	12.567	-28.42	328	5001.8	11.005	-23.03
209	3503.9	14.304	-29.78	269	4308.8	12.539	-28.36	329	5012.7	10.982	-22.90
210	3518.2	14.275	-29.79	270	4321.3	12.511	-28.30	330	5023.7	10.959	-22.78
211	3532.4	14.245	-29.80	271	4333.8	12.482	-28.24	331	5034.4	10.936	-22.66
212	3546.7	14.215	-29.81	272	4346.2	12.454	-28.18	332	5045.6	10.914	-22.53
213	3560.9	14.185	-29.82	273	4358.7	12.426	-28.11	333	5056.5	10.891	-22.41
214	3575.0	14.155	-29.83	274	4371.1	12.398	-28.05	334	5067.4	10.869	-22.28
215	3589.2	14.126	-29.83	275	4383.5	12.370	-27.99	335	5078.2	10.847	-22.15
216	3603.3	14.096	-29.84	276	4395.8	12.342	-27.92	336	5089.1	10.825	-22.03
217	3617.4	14.066	-29.84	277	4408.2	12.314	-27.85	337	5099.9	10.803	-21.90
218	3631.4	14.036	-29.84	278	4420.5	12.286	-27.79	338	5110.7	10.781	-21.77
219	3645.4	14.006	-29.84	279	4432.7	12.258	-27.72	339	5121.4	10.759	-21.63
220	3659.4	13.976	-29.84	280	4445.0	12.231	-27.65	340	5132.2	10.738	-21.50
221	3673.4	13.947	-29.84	281	4457.2	12.203	-27.58	341	5142.9	10.716	-21.37
222	3687.3	13.917	-29.84	282	4469.4	12.176	-27.50	342	5153.6	10.695	-21.23
223	3701.2	13.887	-29.83	283	4481.5	12.148	-27.43	343	5164.3	10.674	-21.10
224	3715.1	13.857	-29.83	284	4493.7	12.121	-27.35	344	5175.0	10.653	-20.96
225	3728.9	13.827	-29.82	285	4505.8	12.093	-27.28	345	5185.6	10.632	-20.83
226	3742.7	13.797	-29.81	286	4517.9	12.066	-27.20	346	5196.2	10.611	-20.69
227	3756.5	13.768	-29.81	287	4529.9	12.039	-27.12	347	5206.8	10.591	-20.55
228	3770.3	13.738	-29.80	288	4541.9	12.012	-27.05	348	5217.4	10.570	-20.41
229	3784.0	13.708	-29.78	289	4553.9	11.985	-26.97	349	5228.0	10.550	-20.27
230	3797.7	13.678	-29.77	290	4565.9	11.958	-26.88	350	5238.5	10.530	-20.13
231	3811.4	13.648	-29.76	291	4577.9	11.931	-26.80	351	5249.0	10.509	-19.98
232	3825.0	13.619	-29.74	292	4589.8	11.904	-26.72	352	5259.5	10.490	-19.84
233	3838.6	13.589	-29.73	293	4601.7	11.878	-26.63	353	5270.0	10.470	-19.69
234	3852.2	13.559	-29.71	294	4613.5	11.851	-26.55	354	5280.5	10.450	-19.55
235	3865.7	13.530	-29.69	295	4625.4	11.825	-26.46	355	5290.9	10.431	-19.40
236	3879.2	13.500	-29.67	296	4637.2	11.798	-26.38	356	5301.3	10.411	-19.25
237	3892.7	13.470	-29.65	297	4649.0	11.772	-26.29	357	5311.7	10.392	-19.11
238	3906.2	13.441	-29.63	298	4660.7	11.746	-26.20	358	5322.1	10.373	-18.96
239	3919.6	13.411	-29.60	299	4672.5	11.720	-26.11	359	5332.5	10.354	-18.81
240	3933.0	13.381	-29.58	300	4684.2	11.693	-26.02	360	5342.8	10.336	-18.65

TABLE 6.4.2. *Type JP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	5342.8	10.336	-18.65	420	5935.3	9.521	-8.02	480	6499.7	9.421	5.02
361	5353.2	10.317	-18.50	421	5944.8	9.513	-7.82	481	6509.1	9.427	5.25
362	5363.5	10.299	-18.35	422	5954.3	9.505	-7.62	482	6518.5	9.432	5.48
363	5373.8	10.280	-18.20	423	5963.8	9.497	-7.42	483	6527.9	9.438	5.71
364	5384.0	10.262	-18.04	424	5973.3	9.490	-7.22	484	6537.4	9.443	5.94
365	5394.3	10.244	-17.88	425	5982.8	9.483	-7.01	485	6546.8	9.449	6.17
366	5404.5	10.226	-17.73	426	5992.3	9.476	-6.81	486	6556.3	9.456	6.40
367	5414.7	10.209	-17.57	427	6001.8	9.469	-6.60	487	6565.7	9.462	6.64
368	5424.9	10.191	-17.41	428	6011.2	9.463	-6.40	488	6575.2	9.469	6.87
369	5435.1	10.174	-17.25	429	6020.7	9.457	-6.19	489	6584.7	9.476	7.10
370	5445.3	10.157	-17.09	430	6030.2	9.450	-5.99	490	6594.2	9.483	7.33
371	5455.4	10.140	-16.93	431	6039.6	9.445	-5.78	491	6603.6	9.491	7.57
372	5465.6	10.123	-16.77	432	6049.0	9.439	-5.57	492	6613.1	9.498	7.80
373	5475.7	10.106	-16.61	433	6058.5	9.433	-5.36	493	6622.6	9.506	8.03
374	5485.8	10.090	-16.44	434	6067.9	9.428	-5.15	494	6632.2	9.514	8.26
375	5495.9	10.073	-16.28	435	6077.3	9.423	-4.94	495	6641.7	9.523	8.50
376	5505.9	10.057	-16.11	436	6086.8	9.418	-4.73	496	6651.2	9.531	8.73
377	5516.0	10.041	-15.95	437	6096.2	9.414	-4.52	497	6660.7	9.540	8.96
378	5526.0	10.025	-15.78	438	6105.6	9.409	-4.31	498	6670.3	9.549	9.20
379	5536.0	10.010	-15.61	439	6115.0	9.405	-4.10	499	6679.8	9.559	9.43
380	5546.0	9.994	-15.44	440	6124.4	9.401	-3.89	500	6689.4	9.568	9.67
381	5556.0	9.979	-15.27	441	6133.8	9.397	-3.67	501	6699.0	9.578	9.90
382	5566.0	9.963	-15.10	442	6143.2	9.394	-3.46	502	6708.6	9.588	10.13
383	5575.9	9.948	-14.93	443	6152.6	9.390	-3.24	503	6718.1	9.598	10.37
384	5585.9	9.934	-14.76	444	6162.0	9.387	-3.03	504	6727.8	9.609	10.60
385	5595.8	9.919	-14.58	445	6171.4	9.384	-2.81	505	6737.4	9.619	10.84
386	5605.7	9.904	-14.41	446	6180.7	9.382	-2.60	506	6747.0	9.630	11.07
387	5615.6	9.890	-14.23	447	6190.1	9.379	-2.38	507	6756.6	9.642	11.30
388	5625.5	9.876	-14.06	448	6199.5	9.377	-2.16	508	6766.3	9.653	11.54
389	5635.4	9.862	-13.88	449	6208.9	9.375	-1.95	509	6775.9	9.665	11.77
390	5645.2	9.848	-13.70	450	6218.2	9.373	-1.73	510	6785.6	9.676	12.01
391	5655.1	9.835	-13.53	451	6227.6	9.371	-1.51	511	6795.3	9.689	12.24
392	5664.9	9.821	-13.35	452	6237.0	9.370	-1.29	512	6805.0	9.701	12.47
393	5674.7	9.808	-13.17	453	6246.4	9.369	-1.07	513	6814.7	9.714	12.71
394	5684.5	9.795	-12.99	454	6255.7	9.368	-0.85	514	6824.4	9.726	12.94
395	5694.3	9.782	-12.81	455	6265.1	9.367	-0.63	515	6834.1	9.739	13.18
396	5704.1	9.769	-12.62	456	6274.5	9.367	-0.41	516	6843.9	9.753	13.41
397	5713.8	9.757	-12.44	457	6283.8	9.366	-0.19	517	6853.6	9.766	13.64
398	5723.6	9.744	-12.26	458	6293.2	9.366	0.03	518	6863.4	9.780	13.88
399	5733.3	9.732	-12.07	459	6302.6	9.366	0.26	519	6873.2	9.794	14.11
400	5743.0	9.720	-11.89	460	6311.9	9.367	0.48	520	6883.0	9.808	14.35
401	5752.8	9.708	-11.70	461	6321.3	9.367	0.70	521	6892.8	9.823	14.58
402	5762.5	9.697	-11.51	462	6330.7	9.368	0.93	522	6902.7	9.837	14.81
403	5772.1	9.685	-11.33	463	6340.0	9.369	1.15	523	6912.5	9.852	15.04
404	5781.8	9.674	-11.14	464	6349.4	9.370	1.38	524	6922.4	9.868	15.28
405	5791.5	9.663	-10.95	465	6358.8	9.372	1.60	525	6932.2	9.883	15.51
406	5801.2	9.652	-10.76	466	6368.1	9.374	1.83	526	6942.1	9.899	15.74
407	5810.8	9.642	-10.57	467	6377.5	9.376	2.05	527	6952.0	9.914	15.97
408	5820.4	9.631	-10.38	468	6386.9	9.378	2.28	528	6962.0	9.930	16.21
409	5830.1	9.621	-10.18	469	6396.3	9.380	2.50	529	6971.9	9.947	16.44
410	5839.7	9.611	-9.99	470	6405.7	9.383	2.73	530	6981.8	9.963	16.67
411	5849.3	9.601	-9.80	471	6415.0	9.386	2.96	531	6991.8	9.980	16.90
412	5858.9	9.591	-9.60	472	6424.4	9.389	3.19	532	7001.8	9.997	17.13
413	5868.5	9.582	-9.41	473	6433.8	9.392	3.41	533	7011.8	10.014	17.36
414	5878.0	9.572	-9.21	474	6443.2	9.395	3.64	534	7021.8	10.032	17.59
415	5887.6	9.563	-9.02	475	6452.6	9.399	3.87	535	7031.9	10.050	17.82
416	5897.2	9.554	-8.82	476	6462.0	9.403	4.10	536	7041.9	10.068	18.05
417	5906.7	9.546	-8.62	477	6471.4	9.407	4.33	537	7052.0	10.086	18.28
418	5916.3	9.537	-8.42	478	6480.8	9.412	4.56	538	7062.1	10.104	18.51
419	5925.8	9.529	-8.22	479	6490.2	9.417	4.79	539	7072.2	10.123	18.74
420	5935.3	9.521	-8.02	480	6499.7	9.421	5.02	540	7082.4	10.142	18.97

TABLE 6.4.2. *Type JP thermoclements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	7082.4	10.142	18.97	600	7732.9	11.668	31.41	660	8495.0	13.808	38.68
541	7092.5	10.161	19.20	601	7744.6	11.700	31.58	661	8508.8	13.847	38.73
542	7102.7	10.180	19.42	602	7756.3	11.731	31.76	662	8522.7	13.886	38.78
543	7112.9	10.200	19.65	603	7768.0	11.763	31.93	663	8536.6	13.924	38.82
544	7123.1	10.219	19.88	604	7779.8	11.795	32.10	664	8550.5	13.963	38.86
545	7133.3	10.239	20.10	605	7791.6	11.827	32.27	665	8564.5	14.002	38.90
546	7143.6	10.259	20.33	606	7803.5	11.860	32.44	666	8578.5	14.041	38.94
547	7153.8	10.280	20.56	607	7815.4	11.892	32.60	667	8592.6	14.080	38.97
548	7164.1	10.301	20.78	608	7827.3	11.925	32.77	668	8606.7	14.119	39.00
549	7174.4	10.321	21.01	609	7839.2	11.958	32.93	669	8620.8	14.158	39.03
550	7184.8	10.343	21.23	610	7851.2	11.991	33.10	670	8635.0	14.197	39.05
551	7195.1	10.364	21.45	611	7863.2	12.024	33.26	671	8649.2	14.236	39.07
552	7205.5	10.386	21.68	612	7875.2	12.057	33.42	672	8663.5	14.275	39.09
553	7215.9	10.407	21.90	613	7887.3	12.091	33.57	673	8677.8	14.314	39.10
554	7226.3	10.429	22.12	614	7899.4	12.125	33.73	674	8692.1	14.353	39.12
555	7236.7	10.452	22.34	615	7911.6	12.158	33.88	675	8706.5	14.392	39.12
556	7247.2	10.474	22.56	616	7923.7	12.192	34.03	676	8720.9	14.432	39.13
557	7257.7	10.497	22.78	617	7935.9	12.226	34.18	677	8735.3	14.471	39.13
558	7268.2	10.520	23.00	618	7948.2	12.261	34.33	678	8749.8	14.510	39.13
559	7278.7	10.543	23.22	619	7960.5	12.295	34.48	679	8764.4	14.549	39.12
560	7289.3	10.566	23.44	620	7972.8	12.330	34.63	680	8778.9	14.588	39.11
561	7299.9	10.590	23.65	621	7985.1	12.364	34.77	681	8793.5	14.627	39.10
562	7310.5	10.613	23.87	622	7997.5	12.399	34.91	682	8808.2	14.666	39.09
563	7321.1	10.637	24.08	623	8009.9	12.434	35.05	683	8822.9	14.705	39.07
564	7331.7	10.661	24.30	624	8022.4	12.469	35.19	684	8837.6	14.744	39.04
565	7342.4	10.686	24.51	625	8034.9	12.505	35.32	685	8852.4	14.783	39.02
566	7353.1	10.710	24.73	626	8047.4	12.540	35.46	686	8867.2	14.822	38.99
567	7363.8	10.735	24.94	627	8059.9	12.575	35.59	687	8882.0	14.861	38.95
568	7374.6	10.760	25.15	628	8072.5	12.611	35.72	688	8896.9	14.900	38.92
569	7385.3	10.786	25.36	629	8085.2	12.647	35.85	689	8911.8	14.939	38.88
570	7396.1	10.811	25.57	630	8097.8	12.683	35.97	690	8926.8	14.978	38.83
571	7407.0	10.837	25.78	631	8110.5	12.719	36.10	691	8941.8	15.017	38.79
572	7417.8	10.863	25.99	632	8123.3	12.755	36.22	692	8956.8	15.056	38.73
573	7428.7	10.889	26.20	633	8136.0	12.791	36.34	693	8971.9	15.094	38.68
574	7439.6	10.915	26.41	634	8148.8	12.828	36.45	694	8987.0	15.133	38.62
575	7450.5	10.942	26.61	635	8161.7	12.864	36.57	695	9002.1	15.172	38.56
576	7461.5	10.968	26.82	636	8174.6	12.901	36.68	696	9017.3	15.210	38.49
577	7472.5	10.995	27.02	637	8187.5	12.938	36.79	697	9032.6	15.249	38.42
578	7483.5	11.022	27.22	638	8200.4	12.974	36.90	698	9047.8	15.287	38.34
579	7494.5	11.050	27.42	639	8213.4	13.011	37.01	699	9063.1	15.325	38.26
580	7505.6	11.077	27.63	640	8226.5	13.048	37.11	700	9078.5	15.363	38.18
581	7516.7	11.105	27.83	641	8239.5	13.086	37.22	701	9093.9	15.402	38.09
582	7527.8	11.133	28.02	642	8252.6	13.123	37.31	702	9109.3	15.440	38.00
583	7538.9	11.161	28.22	643	8265.8	13.160	37.41	703	9124.7	15.478	37.91
584	7550.1	11.189	28.42	644	8279.0	13.198	37.51	704	9140.2	15.515	37.81
585	7561.3	11.218	28.61	645	8292.2	13.235	37.60	705	9155.8	15.553	37.70
586	7572.5	11.246	28.81	646	8305.4	13.273	37.69	706	9171.3	15.591	37.60
587	7583.8	11.275	29.00	647	8318.7	13.311	37.78	707	9186.9	15.628	37.48
588	7595.1	11.304	29.19	648	8332.1	13.348	37.86	708	9202.6	15.666	37.37
589	7606.4	11.334	29.39	649	8345.4	13.386	37.94	709	9218.3	15.703	37.25
590	7617.8	11.363	29.58	650	8358.8	13.424	38.02	710	9234.0	15.740	37.12
591	7629.1	11.393	29.76	651	8372.3	13.462	38.10	711	9249.8	15.777	36.99
592	7640.5	11.423	29.95	652	8385.7	13.501	38.18	712	9265.6	15.814	36.86
593	7652.0	11.453	30.14	653	8399.3	13.539	38.25	713	9281.4	15.851	36.72
594	7663.4	11.483	30.32	654	8412.8	13.577	38.32	714	9297.3	15.888	36.58
595	7674.9	11.513	30.51	655	8426.4	13.615	38.39	715	9313.2	15.924	36.43
596	7686.5	11.544	30.69	656	8440.1	13.654	38.45	716	9329.1	15.961	36.28
597	7698.0	11.575	30.87	657	8453.7	13.692	38.51	717	9345.1	15.997	36.12
598	7709.6	11.606	31.05	658	8467.4	13.731	38.57	718	9361.1	16.033	35.96
599	7721.2	11.637	31.23	659	8481.2	13.769	38.63	719	9377.2	16.069	35.79
600	7732.9	11.668	31.41	660	8495.0	13.808	38.68	720	9393.2	16.104	35.62

TABLE 6.4.2. *Type JP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	9393.2	16.104	35.62	735	9638.7	16.617	32.47	750	9891.5	17.073	28.12
721	9409.4	16.140	35.45	736	9655.3	16.649	32.22	751	9908.5	17.101	27.78
722	9425.5	16.175	35.27	737	9672.0	16.681	31.96	752	9925.7	17.128	27.44
723	9441.7	16.211	35.08	738	9688.7	16.713	31.70	753	9942.8	17.155	27.09
724	9457.9	16.245	34.89	739	9705.4	16.744	31.43	754	9960.0	17.182	26.74
725	9474.2	16.280	34.70	740	9722.2	16.776	31.16	755	9977.2	17.209	26.38
726	9490.5	16.315	34.50	741	9739.0	16.807	30.88	756	9994.4	17.235	26.01
727	9506.8	16.349	34.29	742	9755.8	16.837	30.60	757	10011.6	17.261	25.64
728	9523.2	16.383	34.08	743	9772.7	16.868	30.31	758	10028.9	17.286	25.26
729	9539.6	16.417	33.87	744	9789.5	16.898	30.01	759	10046.2	17.311	24.88
730	9556.0	16.451	33.65	745	9806.4	16.928	29.71	760	10063.5	17.336	24.48
731	9572.5	16.485	33.42	746	9823.4	16.958	29.40				
732	9589.0	16.518	33.19	747	9840.4	16.987	29.09				
733	9605.5	16.551	32.96	748	9857.4	17.016	28.77				
734	9622.1	16.584	32.72	749	9874.4	17.044	28.45				
735	9638.7	16.617	32.47	750	9891.5	17.073	28.12				

TABLE 6.4.3. *Thermoelectric values at the fixed points for Type JP thermoelements versus platinum, Pt-67*

Fixed point	Temp. °C	E μV	S $\mu V/^{\circ}C$	dS/dT $nV/^{\circ}C^2$
Nitrogen TP	-210.002	-2560.3	-0.303	207.88
Nitrogen NBP	-195.802	-2544.4	2.482	184.73
Oxygen NBP	-182.962	-2497.9	4.728	165.41
Carbon Dioxide SP	-78.476	-1336.9	15.573	54.36
Mercury FP	-38.862	-684.5	17.192	28.54
Ice point	0.000	0.0	17.910	9.33
Ether TP	26.870	483.3	18.017	-1.04
Water BP	100.000	1778.5	17.176	-19.91
Benzoic TP	122.370	2157.5	16.690	-23.47
Indium FP	156.634	2714.7	15.815	-27.28
Tin FP	231.9681	3824.6	13.620	-29.74
Bismuth FP	271.442	4339.3	12.470	-28.21
Cadmium FP	321.108	4925.4	11.167	-23.84
Lead FP	327.502	4996.3	11.017	-23.09
Mercury BP	356.660	5308.2	10.399	-19.16
Zinc FP	419.580	5931.3	9.524	-8.11
Sulphur BP	444.674	6168.3	9.385	-2.88
Cu-Al FP	548.23	7166.5	10.305	20.83
Antimony FP	630.74	8107.2	12.709	36.06
Aluminum FP	660.37	8500.1	13.822	38.70

TABLE 6.4.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type JP thermoelements versus platinum, Pt-67*

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-210 to -100 °C	7	2	<0.1	<0.1	<0.1	<0.1
-100 to 0 °C	7	0.8	<0.1	<0.1	<0.1	<0.1
0 to 200 °C	7	1	<0.1	<0.1	<0.1	<0.1
200 to 400 °C	7	2	<0.1	<0.1	<0.1	<0.1
400 to 600 °C	7	20	1	<0.1	<0.1	<0.1
600 to 760 °C	7	60	4	<0.1	<0.1	<0.1

6.5. Reference Functions and Tables for Platinum, Pt-67, Versus the Negative Thermoelement, Type JN, a Copper-Nickel Alloy

The coefficients for the seventh degree expansion for the thermoelectric voltage of Pt-67 versus Type JN thermoelements below 760 °C are given in table 6.5.1. The errors caused by using reduced bit arithmetic for calculating values of the functions are given in table 6.5.4.

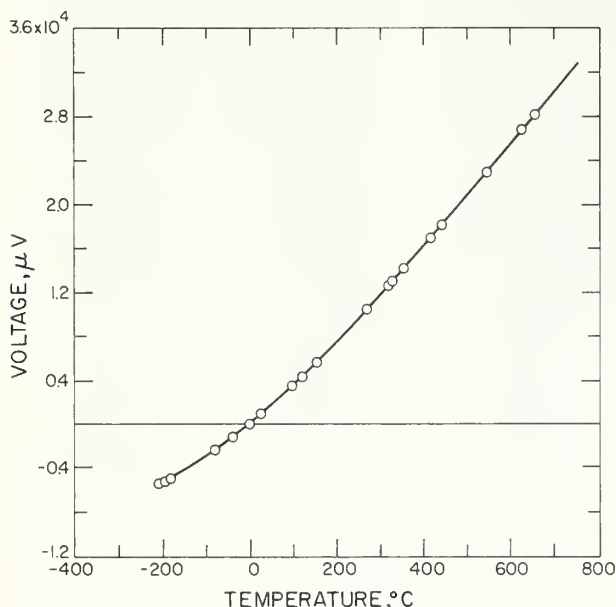


FIGURE 6.5.1. Thermoelectric voltage for platinum, Pt-67, versus Type JN thermoelements. The circles indicate values at various thermometric fixed points on the IPTS-68.

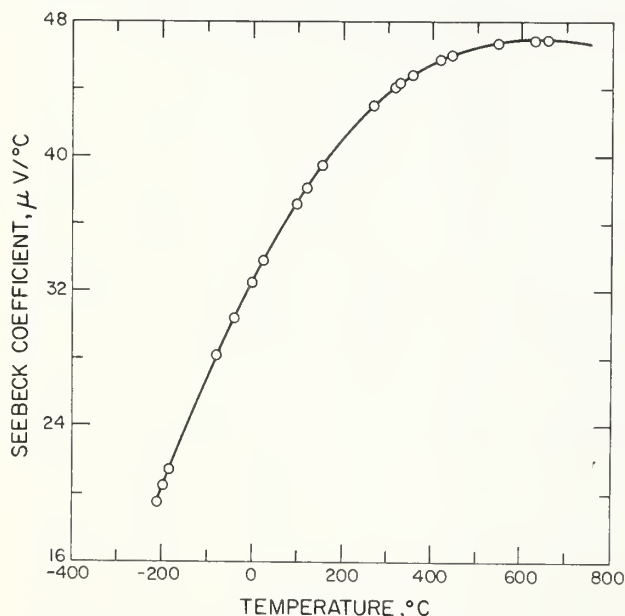


FIGURE 6.5.2. Seebeck coefficient for platinum, Pt-67, versus Type JN thermoelements. The circles indicate values at various thermometric fixed points on the IPTS-68.

The primary reference values for Pt-67 versus Type JN thermoelements are given in table 6.5.2. Values at selected fixed points are given in table 6.5.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 6.5.1, 6.5.2, and 6.5.3, respectively.

Because of the lack of stability of Type J thermocouples above 760 °C, no reference functions are given for Type JN above 760 °C.

The tables in this section merely give average values for industrial materials which have a wide variability. **The tables in this section do NOT contain standardized values.** Neither the ASTM nor the ISA recognize Type JP or JN thermoelements as standardized materials.

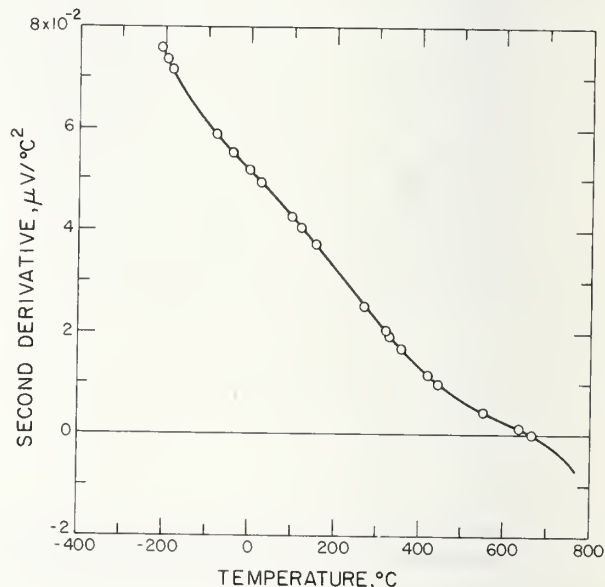


FIGURE 6.5.3. Second derivative of thermoelectric voltage for platinum, Pt-67, versus Type JN thermoelements. The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 6.5.1. Power series expansion for the thermoelectric voltage of platinum, Pt-67, versus Type JN thermoelements

Temperature range	Degree	Coefficients	Term
-210 to 760 °C	7	3.2462432823×10^1	T
		$2.5760715174 \times 10^{-2}$	T^2
		$-1.4497289855 \times 10^{-5}$	T^3
		$-2.3391503000 \times 10^{-10}$	T^4
		$-1.9766432760 \times 10^{-11}$	T^5
		$4.0770759899 \times 10^{-14}$	T^6
		$-2.1133897427 \times 10^{-17}$	T^7

TABLE 6.5.2. *Platinum, Pt-67, versus Type JN thermoelements—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0°C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-210	-5535.3	19.429	76.07	-200	-5337.2	20.180	74.21	-190	-5131.8	20.913	72.47
-209	-5515.8	19.505	75.88	-199	-5317.0	20.254	74.03	-189	-5110.8	20.986	72.30
-208	-5496.3	19.581	75.69	-198	-5296.7	20.328	73.85	-188	-5089.8	21.058	72.14
-207	-5476.7	19.656	75.50	-197	-5276.4	20.402	73.68	-187	-5068.7	21.130	71.97
-206	-5457.0	19.732	75.31	-196	-5255.9	20.475	73.50	-186	-5047.5	21.202	71.81
-205	-5437.2	19.807	75.12	-195	-5235.4	20.549	73.33	-185	-5026.3	21.274	71.65
-204	-5417.4	19.882	74.94	-194	-5214.8	20.622	73.15	-184	-5005.0	21.345	71.48
-203	-5397.5	19.957	74.75	-193	-5194.2	20.695	72.98	-183	-4983.6	21.417	71.32
-202	-5377.5	20.031	74.57	-192	-5173.4	20.768	72.81	-182	-4962.2	21.488	71.16
-201	-5357.4	20.106	74.39	-191	-5152.6	20.841	72.64	-181	-4940.6	21.559	71.00
-200	-5337.2	20.180	74.21	-190	-5131.8	20.913	72.47	-180	-4919.0	21.630	70.84

TABLE 6.5.2. *Platinum, Pt-67, versus Type JN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-180	-4919.0	21.630	70.84	-120	-3498.9	25.628	62.88	-60	-1851.9	29.213	56.83
-179	-4897.4	21.701	70.69	-119	-3473.3	25.691	62.77	-59	-1822.6	29.270	56.74
-178	-4875.6	21.771	70.53	-118	-3447.5	25.754	62.65	-58	-1793.3	29.327	56.65
-177	-4853.8	21.842	70.38	-117	-3421.7	25.816	62.54	-57	-1764.0	29.383	56.56
-176	-4832.0	21.912	70.22	-116	-3395.9	25.879	62.43	-56	-1734.6	29.440	56.47
-175	-4810.0	21.982	70.07	-115	-3370.0	25.941	62.32	-55	-1705.1	29.496	56.37
-174	-4788.0	22.052	69.92	-114	-3344.0	26.003	62.21	-54	-1675.6	29.553	56.28
-173	-4765.9	22.122	69.77	-113	-3318.0	26.066	62.10	-53	-1646.0	29.609	56.19
-172	-4743.7	22.192	69.62	-112	-3291.9	26.128	61.99	-52	-1616.3	29.665	56.10
-171	-4721.5	22.261	69.47	-111	-3265.7	26.190	61.88	-51	-1586.7	29.721	56.01
-170	-4699.2	22.331	69.32	-110	-3239.5	26.251	61.78	-50	-1556.9	29.777	55.92
-169	-4676.9	22.400	69.17	-109	-3213.2	26.313	61.67	-49	-1527.1	29.833	55.83
-168	-4654.4	22.469	69.02	-108	-3186.9	26.375	61.56	-48	-1497.2	29.889	55.74
-167	-4631.9	22.538	68.88	-107	-3160.5	26.436	61.45	-47	-1467.3	29.944	55.65
-166	-4609.3	22.607	68.73	-106	-3134.0	26.498	61.35	-46	-1437.3	30.000	55.56
-165	-4586.7	22.675	68.59	-105	-3107.5	26.559	61.24	-45	-1407.3	30.056	55.47
-164	-4564.0	22.744	68.45	-104	-3080.9	26.620	61.14	-44	-1377.2	30.111	55.38
-163	-4541.2	22.812	68.30	-103	-3054.2	26.681	61.03	-43	-1347.1	30.166	55.29
-162	-4518.4	22.880	68.16	-102	-3027.5	26.742	60.93	-42	-1316.9	30.222	55.20
-161	-4495.5	22.949	68.02	-101	-3000.8	26.803	60.82	-41	-1286.7	30.277	55.11
-160	-4472.5	23.017	67.88	-100	-2973.9	26.864	60.72	-40	-1256.4	30.332	55.02
-159	-4449.4	23.084	67.74	-99	-2947.0	26.924	60.61	-39	-1226.0	30.387	54.94
-158	-4426.3	23.152	67.60	-98	-2920.1	26.985	60.51	-38	-1195.6	30.442	54.85
-157	-4403.1	23.220	67.47	-97	-2893.1	27.046	60.41	-37	-1165.1	30.496	54.76
-156	-4379.9	23.287	67.33	-96	-2866.0	27.106	60.31	-36	-1134.6	30.551	54.67
-155	-4356.5	23.354	67.19	-95	-2838.8	27.166	60.20	-35	-1104.0	30.606	54.58
-154	-4333.2	23.421	67.06	-94	-2811.6	27.226	60.10	-34	-1073.4	30.660	54.49
-153	-4309.7	23.488	66.92	-93	-2784.4	27.286	60.00	-33	-1042.7	30.715	54.40
-152	-4286.2	23.555	66.79	-92	-2757.1	27.346	59.90	-32	-1011.9	30.769	54.32
-151	-4262.6	23.622	66.66	-91	-2729.7	27.406	59.80	-31	-981.1	30.823	54.23
-150	-4238.9	23.689	66.53	-90	-2702.3	27.466	59.70	-30	-950.3	30.878	54.14
-149	-4215.2	23.755	66.40	-89	-2674.8	27.526	59.60	-29	-919.4	30.932	54.05
-148	-4191.4	23.821	66.26	-88	-2647.2	27.585	59.50	-28	-888.4	30.986	53.96
-147	-4167.6	23.888	66.14	-87	-2619.6	27.645	59.40	-27	-857.4	31.040	53.88
-146	-4143.7	23.954	66.01	-86	-2591.9	27.704	59.30	-26	-826.4	31.093	53.79
-145	-4119.7	24.020	65.88	-85	-2564.2	27.763	59.21	-25	-795.2	31.147	53.70
-144	-4095.6	24.085	65.75	-84	-2536.4	27.822	59.11	-24	-764.1	31.201	53.61
-143	-4071.5	24.151	65.62	-83	-2508.5	27.881	59.01	-23	-732.8	31.254	53.53
-142	-4047.3	24.217	65.50	-82	-2480.6	27.940	58.91	-22	-701.6	31.308	53.44
-141	-4023.1	24.282	65.37	-81	-2452.7	27.999	58.81	-21	-670.2	31.361	53.35
-140	-3998.7	24.347	65.25	-80	-2424.6	28.058	58.72	-20	-638.8	31.415	53.26
-139	-3974.4	24.413	65.12	-79	-2396.5	28.117	58.62	-19	-607.4	31.468	53.18
-138	-3949.9	24.478	65.00	-78	-2368.4	28.175	58.52	-18	-575.9	31.521	53.09
-137	-3925.4	24.543	64.88	-77	-2340.2	28.234	58.43	-17	-544.3	31.574	53.00
-136	-3900.8	24.607	64.75	-76	-2311.9	28.292	58.33	-16	-512.7	31.627	52.91
-135	-3876.2	24.672	64.63	-75	-2283.6	28.350	58.24	-15	-481.1	31.680	52.83
-134	-3851.5	24.737	64.51	-74	-2255.2	28.409	58.14	-14	-449.4	31.733	52.74
-133	-3826.7	24.801	64.39	-73	-2226.8	28.467	58.05	-13	-417.6	31.785	52.65
-132	-3801.9	24.865	64.27	-72	-2198.3	28.525	57.95	-12	-385.8	31.838	52.57
-131	-3777.0	24.930	64.15	-71	-2169.7	28.583	57.86	-11	-354.0	31.890	52.48
-130	-3752.0	24.994	64.03	-70	-2141.1	28.640	57.76	-10	-322.0	31.943	52.39
-129	-3727.0	25.058	63.91	-69	-2112.5	28.698	57.67	-9	-290.1	31.995	52.30
-128	-3701.9	25.121	63.80	-68	-2083.7	28.756	57.58	-8	-258.0	32.047	52.22
-127	-3676.8	25.185	63.68	-67	-2055.0	28.813	57.48	-7	-226.0	32.100	52.13
-126	-3651.5	25.249	63.56	-66	-2026.1	28.871	57.39	-6	-193.8	32.152	52.04
-125	-3626.3	25.312	63.45	-65	-1997.2	28.928	57.29	-5	-161.7	32.204	51.96
-124	-3600.9	25.376	63.33	-64	-1968.3	28.985	57.20	-4	-129.4	32.256	51.87
-123	-3575.5	25.439	63.22	-63	-1939.2	29.042	57.11	-3	-97.2	32.307	51.78
-122	-3550.0	25.502	63.10	-62	-1910.2	29.099	57.02	-2	-64.8	32.359	51.70
-121	-3524.5	25.565	62.99	-61	-1881.0	29.156	56.92	-1	-32.4	32.411	51.61
-120	-3498.9	25.628	62.88	-60	-1851.9	29.213	56.83	0	0.0	32.462	51.52

TABLE 6.5.2. *Platinum, Pt-67, versus Type JN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.0	32.462	51.52	60	2037.3	35.396	46.22	120	4241.0	38.002	40.59
1	32.5	32.514	51.43	61	2072.8	35.442	46.13	121	4279.0	38.043	40.49
2	65.0	32.565	51.35	62	2108.2	35.488	46.04	122	4317.1	38.083	40.40
3	97.6	32.617	51.26	63	2143.7	35.534	45.95	123	4355.2	38.124	40.30
4	130.3	32.668	51.17	64	2179.3	35.580	45.86	124	4393.3	38.164	40.20
5	163.0	32.719	51.09	65	2214.9	35.626	45.77	125	4431.5	38.204	40.10
6	195.7	32.770	51.00	66	2250.5	35.672	45.68	126	4469.7	38.244	40.01
7	228.5	32.821	50.91	67	2286.2	35.717	45.59	127	4508.0	38.284	39.91
8	261.3	32.872	50.83	68	2322.0	35.763	45.49	128	4546.3	38.324	39.81
9	294.2	32.923	50.74	69	2357.8	35.808	45.40	129	4584.6	38.364	39.71
10	327.2	32.973	50.65	70	2393.6	35.854	45.31	130	4623.0	38.403	39.61
11	360.2	33.024	50.56	71	2429.5	35.899	45.22	131	4661.4	38.443	39.52
12	393.2	33.074	50.48	72	2465.4	35.944	45.13	132	4699.9	38.482	39.42
13	426.3	33.125	50.39	73	2501.4	35.989	45.04	133	4738.4	38.522	39.32
14	459.5	33.175	50.30	74	2537.4	36.034	44.94	134	4776.9	38.561	39.22
15	492.7	33.225	50.21	75	2573.4	36.079	44.85	135	4815.5	38.600	39.12
16	525.9	33.276	50.13	76	2609.5	36.124	44.76	136	4854.1	38.639	39.02
17	559.2	33.326	50.04	77	2645.7	36.168	44.67	137	4892.8	38.678	38.92
18	592.6	33.376	49.95	78	2681.9	36.213	44.57	138	4931.5	38.717	38.82
19	626.0	33.426	49.87	79	2718.1	36.258	44.48	139	4970.2	38.756	38.73
20	659.4	33.475	49.78	80	2754.4	36.302	44.39	140	5009.0	38.795	38.63
21	692.9	33.525	49.69	81	2790.7	36.346	44.30	141	5047.8	38.833	38.53
22	726.5	33.575	49.60	82	2827.1	36.391	44.20	142	5086.7	38.872	38.43
23	760.1	33.624	49.51	83	2863.5	36.435	44.11	143	5125.6	38.910	38.33
24	793.7	33.674	49.43	84	2899.9	36.479	44.02	144	5164.5	38.948	38.23
25	827.4	33.723	49.34	85	2936.4	36.523	43.92	145	5203.5	38.986	38.13
26	861.2	33.773	49.25	86	2973.0	36.567	43.83	146	5242.5	39.024	38.03
27	895.0	33.822	49.16	87	3009.6	36.610	43.74	147	5281.5	39.062	37.93
28	928.8	33.871	49.08	88	3046.2	36.654	43.64	148	5320.6	39.100	37.83
29	962.7	33.920	48.99	89	3082.9	36.698	43.55	149	5359.7	39.138	37.73
30	996.7	33.969	48.90	90	3119.6	36.741	43.46	150	5398.9	39.176	37.63
31	1030.7	34.018	48.81	91	3156.4	36.785	43.36	151	5438.1	39.213	37.53
32	1064.7	34.066	48.72	92	3193.2	36.828	43.27	152	5477.3	39.251	37.43
33	1098.8	34.115	48.64	93	3230.0	36.871	43.18	153	5516.6	39.288	37.33
34	1132.9	34.164	48.55	94	3266.9	36.914	43.08	154	5555.9	39.325	37.23
35	1167.1	34.212	48.46	95	3303.8	36.957	42.99	155	5595.2	39.363	37.13
36	1201.4	34.261	48.37	96	3340.8	37.000	42.89	156	5634.6	39.400	37.03
37	1235.6	34.309	48.28	97	3377.8	37.043	42.80	157	5674.0	39.437	36.92
38	1270.0	34.357	48.19	98	3414.9	37.086	42.70	158	5713.5	39.474	36.82
39	1304.4	34.405	48.10	99	3452.0	37.129	42.61	159	5753.0	39.510	36.72
40	1338.8	34.453	48.02	100	3489.2	37.171	42.51	160	5792.5	39.547	36.62
41	1373.3	34.501	47.93	101	3526.4	37.214	42.42	161	5832.0	39.584	36.52
42	1407.8	34.549	47.84	102	3563.6	37.256	42.32	162	5871.7	39.620	36.42
43	1442.4	34.597	47.75	103	3600.9	37.298	42.23	163	5911.3	39.656	36.32
44	1477.0	34.645	47.66	104	3638.2	37.340	42.13	164	5951.0	39.693	36.22
45	1511.6	34.692	47.57	105	3675.6	37.383	42.04	165	5990.7	39.729	36.11
46	1546.4	34.740	47.48	106	3713.0	37.425	41.94	166	6030.4	39.765	36.01
47	1581.1	34.787	47.39	107	3750.4	37.466	41.85	167	6070.2	39.801	35.91
48	1615.9	34.835	47.30	108	3787.9	37.508	41.75	168	6110.0	39.837	35.81
49	1650.8	34.882	47.21	109	3825.4	37.550	41.65	169	6149.9	39.873	35.71
50	1685.7	34.929	47.12	110	3863.0	37.592	41.56	170	6189.8	39.908	35.61
51	1720.7	34.976	47.03	111	3900.6	37.633	41.46	171	6229.7	39.944	35.50
52	1755.7	35.023	46.94	112	3938.3	37.674	41.37	172	6269.7	39.979	35.40
53	1790.7	35.070	46.85	113	3976.0	37.716	41.27	173	6309.7	40.015	35.30
54	1825.8	35.117	46.76	114	4013.7	37.757	41.17	174	6349.7	40.050	35.20
55	1860.9	35.164	46.67	115	4051.5	37.798	41.08	175	6389.8	40.085	35.10
56	1896.1	35.210	46.58	116	4089.3	37.839	40.98	176	6429.9	40.120	34.99
57	1931.4	35.257	46.49	117	4127.1	37.880	40.88	177	6470.0	40.155	34.89
58	1966.6	35.303	46.40	118	4165.0	37.921	40.79	178	6510.2	40.190	34.79
59	2002.0	35.350	46.31	119	4203.0	37.962	40.69	179	6550.4	40.225	34.69
60	2037.3	35.396	46.22	120	4241.0	38.002	40.59	180	6590.6	40.259	34.58

TABLE 6.5.2. *Platinum, Pt-67, versus Type JN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	6590.6	40.259	34.58	240	9064.7	42.148	28.37	300	11640.9	43.665	22.25
181	6630.9	40.294	34.48	241	9106.9	42.176	28.27	301	11684.6	43.688	22.15
182	6671.2	40.328	34.38	242	9149.1	42.205	28.16	302	11728.3	43.710	22.05
183	6711.5	40.362	34.28	243	9191.3	42.233	28.06	303	11772.0	43.732	21.95
184	6751.9	40.397	34.17	244	9233.5	42.261	27.96	304	11815.8	43.754	21.85
185	6792.3	40.431	34.07	245	9275.8	42.289	27.85	305	11859.5	43.775	21.76
186	6832.8	40.465	33.97	246	9318.1	42.316	27.75	306	11903.3	43.797	21.66
187	6873.3	40.499	33.86	247	9360.4	42.344	27.64	307	11947.1	43.819	21.56
188	6913.8	40.533	33.76	248	9402.8	42.372	27.54	308	11991.0	43.840	21.46
189	6954.3	40.566	33.66	249	9445.2	42.399	27.44	309	12034.8	43.862	21.36
190	6994.9	40.600	33.56	250	9487.6	42.427	27.33	310	12078.7	43.883	21.26
191	7035.5	40.633	33.45	251	9530.0	42.454	27.23	311	12122.6	43.904	21.17
192	7076.2	40.667	33.35	252	9572.5	42.481	27.13	312	12166.5	43.925	21.07
193	7116.9	40.700	33.25	253	9615.0	42.508	27.02	313	12210.4	43.946	20.97
194	7157.6	40.733	33.14	254	9657.5	42.535	26.92	314	12254.4	43.967	20.87
195	7198.3	40.766	33.04	255	9700.1	42.562	26.82	315	12298.4	43.988	20.78
196	7239.1	40.799	32.94	256	9742.6	42.589	26.71	316	12342.4	44.009	20.68
197	7279.9	40.832	32.83	257	9785.2	42.615	26.61	317	12386.4	44.029	20.58
198	7320.8	40.865	32.73	258	9827.9	42.642	26.51	318	12430.4	44.050	20.49
199	7361.7	40.898	32.63	259	9870.5	42.668	26.41	319	12474.5	44.070	20.39
200	7402.6	40.930	32.52	260	9913.2	42.695	26.30	320	12518.6	44.091	20.29
201	7443.5	40.963	32.42	261	9955.9	42.721	26.20	321	12562.7	44.111	20.20
202	7484.5	40.995	32.32	262	9998.6	42.747	26.10	322	12606.8	44.131	20.10
203	7525.5	41.027	32.21	263	10041.4	42.773	25.99	323	12650.9	44.151	20.00
204	7566.6	41.060	32.11	264	10084.2	42.799	25.89	324	12695.1	44.171	19.91
205	7607.6	41.092	32.00	265	10127.0	42.825	25.79	325	12739.3	44.191	19.81
206	7648.7	41.124	31.90	266	10169.8	42.851	25.69	326	12783.5	44.211	19.72
207	7689.9	41.155	31.80	267	10212.7	42.876	25.58	327	12827.7	44.230	19.62
208	7731.0	41.187	31.69	268	10255.6	42.902	25.48	328	12871.9	44.250	19.53
209	7772.3	41.219	31.59	269	10298.5	42.927	25.38	329	12916.2	44.269	19.43
210	7813.5	41.250	31.49	270	10341.4	42.953	25.28	330	12960.5	44.289	19.34
211	7854.8	41.282	31.38	271	10384.4	42.978	25.17	331	13004.8	44.308	19.24
212	7896.1	41.313	31.28	272	10427.4	43.003	25.07	332	13049.1	44.327	19.15
213	7937.4	41.344	31.17	273	10470.4	43.028	24.97	333	13093.4	44.346	19.05
214	7978.7	41.375	31.07	274	10513.5	43.053	24.87	334	13137.8	44.365	18.96
215	8020.1	41.406	30.97	275	10556.5	43.078	24.77	335	13182.2	44.384	18.86
216	8061.6	41.437	30.86	276	10599.6	43.103	24.66	336	13226.5	44.403	18.77
217	8103.0	41.468	30.76	277	10642.7	43.127	24.56	337	13271.0	44.422	18.68
218	8144.5	41.499	30.66	278	10685.9	43.152	24.46	338	13315.4	44.441	18.58
219	8186.0	41.529	30.55	279	10729.0	43.176	24.36	339	13359.8	44.459	18.49
220	8227.5	41.560	30.45	280	10772.2	43.200	24.26	340	13404.3	44.477	18.40
221	8269.1	41.590	30.34	281	10815.4	43.225	24.16	341	13448.8	44.496	18.30
222	8310.7	41.621	30.24	282	10858.7	43.249	24.06	342	13493.3	44.514	18.21
223	8352.4	41.651	30.14	283	10901.9	43.273	23.95	343	13537.8	44.532	18.12
224	8394.0	41.681	30.03	284	10945.2	43.297	23.85	344	13582.4	44.550	18.03
225	8435.7	41.711	29.93	285	10988.5	43.320	23.75	345	13626.9	44.568	17.93
226	8477.5	41.741	29.82	286	11031.9	43.344	23.65	346	13671.5	44.586	17.84
227	8519.2	41.771	29.72	287	11075.2	43.368	23.55	347	13716.1	44.604	17.75
228	8561.0	41.800	29.62	288	11118.6	43.391	23.45	348	13760.7	44.622	17.66
229	8602.8	41.830	29.51	289	11162.0	43.415	23.35	349	13805.3	44.639	17.57
230	8644.7	41.859	29.41	290	11205.4	43.438	23.25	350	13850.0	44.657	17.48
231	8686.5	41.889	29.30	291	11248.9	43.461	23.15	351	13894.7	44.674	17.39
232	8728.4	41.918	29.20	292	11292.3	43.484	23.05	352	13939.3	44.692	17.29
233	8770.4	41.947	29.10	293	11335.8	43.507	22.95	353	13984.0	44.709	17.20
234	8812.3	41.976	28.99	294	11379.4	43.530	22.85	354	14028.8	44.726	17.11
235	8854.3	42.005	28.89	295	11422.9	43.553	22.75	355	14073.5	44.743	17.02
236	8896.3	42.034	28.78	296	11466.5	43.576	22.65	356	14118.2	44.760	16.93
237	8938.4	42.063	28.68	297	11510.0	43.598	22.55	357	14163.0	44.777	16.84
238	8980.5	42.091	28.58	298	11553.7	43.621	22.45	358	14207.8	44.794	16.75
239	9022.6	42.120	28.47	299	11597.3	43.643	22.35	359	14252.6	44.810	16.66
240	9064.7	42.148	28.37	300	11640.9	43.665	22.25	360	14297.4	44.827	16.58

TABLE 6.5.2. *Platinum, Pt-67, versus Type JN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	14297.4	44.827	16.58	420	17013.8	45.670	11.66	480	19772.5	46.246	7.71
361	14342.3	44.844	16.49	421	17059.5	45.681	11.59	481	19818.7	46.254	7.66
362	14387.1	44.860	16.40	422	17105.2	45.693	11.52	482	19865.0	46.261	7.60
363	14432.0	44.876	16.31	423	17150.9	45.704	11.44	483	19911.2	46.269	7.54
364	14476.9	44.893	16.22	424	17196.6	45.716	11.37	484	19957.5	46.276	7.49
365	14521.8	44.909	16.13	425	17242.3	45.727	11.30	485	20003.8	46.284	7.43
366	14566.7	44.925	16.05	426	17288.0	45.738	11.22	486	20050.1	46.291	7.37
367	14611.6	44.941	15.96	427	17333.8	45.750	11.15	487	20096.4	46.299	7.32
368	14656.6	44.957	15.87	428	17379.5	45.761	11.08	488	20142.7	46.306	7.26
369	14701.5	44.973	15.78	429	17425.3	45.772	11.01	489	20189.0	46.313	7.21
370	14746.5	44.988	15.70	430	17471.1	45.783	10.94	490	20235.3	46.320	7.15
371	14791.5	45.004	15.61	431	17516.9	45.794	10.86	491	20281.6	46.328	7.10
372	14836.5	45.020	15.52	432	17562.7	45.804	10.79	492	20328.0	46.335	7.04
373	14881.5	45.035	15.44	433	17608.5	45.815	10.72	493	20374.3	46.342	6.99
374	14926.6	45.051	15.35	434	17654.3	45.826	10.65	494	20420.6	46.349	6.94
375	14971.6	45.066	15.27	435	17700.1	45.837	10.58	495	20467.0	46.355	6.88
376	15016.7	45.081	15.18	436	17746.0	45.847	10.51	496	20513.3	46.362	6.83
377	15061.8	45.096	15.09	437	17791.8	45.858	10.44	497	20559.7	46.369	6.78
378	15106.9	45.111	15.01	438	17837.7	45.868	10.37	498	20606.1	46.376	6.72
379	15152.0	45.126	14.93	439	17883.5	45.878	10.30	499	20652.5	46.383	6.67
380	15197.2	45.141	14.84	440	17929.4	45.889	10.23	500	20698.8	46.389	6.62
381	15242.3	45.156	14.76	441	17975.3	45.899	10.17	501	20745.2	46.396	6.57
382	15287.5	45.171	14.67	442	18021.2	45.909	10.10	502	20791.6	46.402	6.51
383	15332.6	45.185	14.59	443	18067.1	45.919	10.03	503	20838.0	46.409	6.46
384	15377.8	45.200	14.50	444	18113.1	45.929	9.96	504	20884.5	46.415	6.41
385	15423.0	45.214	14.42	445	18159.0	45.939	9.90	505	20930.9	46.422	6.36
386	15468.3	45.229	14.34	446	18204.9	45.949	9.83	506	20977.3	46.428	6.31
387	15513.5	45.243	14.26	447	18250.9	45.959	9.76	507	21023.7	46.434	6.26
388	15558.8	45.257	14.17	448	18296.9	45.968	9.69	508	21070.2	46.441	6.21
389	15604.0	45.271	14.09	449	18342.8	45.978	9.63	509	21116.6	46.447	6.16
390	15649.3	45.285	14.01	450	18388.8	45.988	9.56	510	21163.1	46.453	6.11
391	15694.6	45.299	13.93	451	18434.8	45.997	9.50	511	21209.5	46.459	6.06
392	15739.9	45.313	13.84	452	18480.8	46.007	9.43	512	21256.0	46.465	6.01
393	15785.2	45.327	13.76	453	18526.8	46.016	9.37	513	21302.4	46.471	5.96
394	15830.5	45.341	13.68	454	18572.8	46.025	9.30	514	21348.9	46.477	5.91
395	15875.9	45.354	13.60	455	18618.9	46.035	9.24	515	21395.4	46.483	5.87
396	15921.3	45.368	13.52	456	18664.9	46.044	9.17	516	21441.9	46.489	5.82
397	15966.6	45.381	13.44	457	18711.0	46.053	9.11	517	21488.4	46.494	5.77
398	16012.0	45.395	13.36	458	18757.0	46.062	9.04	518	21534.9	46.500	5.72
399	16057.4	45.408	13.28	459	18803.1	46.071	8.98	519	21581.4	46.506	5.67
400	16102.8	45.421	13.20	460	18849.2	46.080	8.92	520	21627.9	46.511	5.63
401	16148.3	45.434	13.12	461	18895.2	46.089	8.86	521	21674.4	46.517	5.58
402	16193.7	45.448	13.04	462	18941.3	46.098	8.79	522	21720.9	46.523	5.53
403	16239.2	45.461	12.96	463	18987.4	46.106	8.73	523	21767.4	46.528	5.49
404	16284.6	45.473	12.88	464	19033.5	46.115	8.67	524	21814.0	46.534	5.44
405	16330.1	45.486	12.81	465	19079.7	46.124	8.61	525	21860.5	46.539	5.39
406	16375.6	45.499	12.73	466	19125.8	46.132	8.55	526	21907.1	46.544	5.35
407	16421.1	45.512	12.65	467	19171.9	46.141	8.48	527	21953.6	46.550	5.30
408	16466.6	45.524	12.57	468	19218.1	46.149	8.42	528	22000.2	46.555	5.26
409	16512.2	45.537	12.50	469	19264.2	46.158	8.36	529	22046.7	46.560	5.21
410	16557.7	45.549	12.42	470	19310.4	46.166	8.30	530	22093.3	46.565	5.17
411	16603.3	45.562	12.34	471	19356.6	46.174	8.24	531	22139.8	46.571	5.12
412	16648.8	45.574	12.27	472	19402.7	46.182	8.18	532	22186.4	46.576	5.08
413	16694.4	45.586	12.19	473	19448.9	46.191	8.12	533	22233.0	46.581	5.03
414	16740.0	45.598	12.11	474	19495.1	46.199	8.06	534	22279.6	46.586	4.99
415	16785.6	45.611	12.04	475	19541.3	46.207	8.00	535	22326.2	46.591	4.94
416	16831.2	45.623	11.96	476	19587.5	46.215	7.95	536	22372.8	46.596	4.90
417	16876.8	45.634	11.89	477	19633.8	46.223	7.89	537	22419.4	46.601	4.86
418	16922.5	45.646	11.81	478	19680.0	46.231	7.83	538	22466.0	46.605	4.81
419	16968.1	45.658	11.74	479	19726.2	46.238	7.77	539	22512.6	46.610	4.77
420	17013.8	45.670	11.66	480	19772.5	46.246	7.71	540	22559.2	46.615	4.73

TABLE 6.5.2. *Platinum, Pt-67, versus Type JN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	22559.2	46.615	4.73	600	25363.1	46.827	2.42	660	28175.8	46.907	0.16
541	22605.8	46.620	4.69	601	25410.0	46.830	2.39	661	28222.7	46.907	0.12
542	22652.4	46.624	4.64	602	25456.8	46.832	2.35	662	28269.7	46.907	0.07
543	22699.0	46.629	4.60	603	25503.6	46.834	2.32	663	28316.6	46.907	0.03
544	22745.7	46.633	4.56	604	25550.5	46.837	2.28	664	28363.5	46.907	-0.02
545	22792.3	46.638	4.52	605	25597.3	46.839	2.25	665	28410.4	46.907	-0.06
546	22839.0	46.643	4.47	606	25644.1	46.841	2.21	666	28457.3	46.907	-0.10
547	22885.6	46.647	4.43	607	25691.0	46.843	2.18	667	28504.2	46.907	-0.15
548	22932.2	46.651	4.39	608	25737.8	46.846	2.14	668	28551.1	46.907	-0.19
549	22978.9	46.656	4.35	609	25784.7	46.848	2.10	669	28598.0	46.907	-0.24
550	23025.6	46.660	4.31	610	25831.5	46.850	2.07	670	28644.9	46.906	-0.29
551	23072.2	46.664	4.27	611	25878.4	46.852	2.03	671	28691.8	46.906	-0.33
552	23118.9	46.669	4.23	612	25925.2	46.854	2.00	672	28738.7	46.906	-0.38
553	23165.6	46.673	4.19	613	25972.1	46.856	1.96	673	28785.6	46.905	-0.42
554	23212.2	46.677	4.15	614	26018.9	46.858	1.93	674	28832.5	46.905	-0.47
555	23258.9	46.681	4.11	615	26065.8	46.860	1.89	675	28879.4	46.904	-0.52
556	23305.6	46.685	4.07	616	26112.7	46.862	1.85	676	28926.3	46.904	-0.57
557	23352.3	46.689	4.03	617	26159.5	46.863	1.82	677	28973.2	46.903	-0.62
558	23399.0	46.693	3.99	618	26206.4	46.865	1.78	678	29020.1	46.903	-0.66
559	23445.7	46.697	3.95	619	26253.3	46.867	1.75	679	29067.0	46.902	-0.71
560	23492.4	46.701	3.91	620	26300.1	46.869	1.71	680	29113.9	46.901	-0.76
561	23539.1	46.705	3.87	621	26347.0	46.870	1.67	681	29160.8	46.900	-0.81
562	23585.8	46.709	3.83	622	26393.9	46.872	1.64	682	29207.7	46.899	-0.86
563	23632.5	46.713	3.79	623	26440.7	46.874	1.60	683	29254.6	46.899	-0.91
564	23679.2	46.716	3.75	624	26487.6	46.875	1.56	684	29301.5	46.898	-0.97
565	23725.9	46.720	3.71	625	26534.5	46.877	1.53	685	29348.4	46.897	-1.02
566	23772.6	46.724	3.67	626	26581.4	46.878	1.49	686	29395.3	46.896	-1.07
567	23819.4	46.728	3.64	627	26628.2	46.880	1.45	687	29442.2	46.894	-1.12
568	23866.1	46.731	3.60	628	26675.1	46.881	1.42	688	29489.1	46.893	-1.18
569	23912.8	46.735	3.56	629	26722.0	46.883	1.38	689	29536.0	46.892	-1.23
570	23959.6	46.738	3.52	630	26768.9	46.884	1.34	690	29582.9	46.891	-1.28
571	24006.3	46.742	3.48	631	26815.8	46.885	1.31	691	29629.8	46.890	-1.34
572	24053.1	46.745	3.45	632	26862.7	46.887	1.27	692	29676.7	46.888	-1.39
573	24099.8	46.749	3.41	633	26909.5	46.888	1.23	693	29723.6	46.887	-1.45
574	24146.6	46.752	3.37	634	26956.4	46.889	1.19	694	29770.5	46.885	-1.50
575	24193.3	46.755	3.33	635	27003.3	46.890	1.16	695	29817.3	46.884	-1.56
576	24240.1	46.759	3.30	636	27050.2	46.891	1.12	696	29864.2	46.882	-1.62
577	24286.8	46.762	3.26	637	27097.1	46.892	1.08	697	29911.1	46.881	-1.68
578	24333.6	46.765	3.22	638	27144.0	46.893	1.04	698	29958.0	46.879	-1.73
579	24380.4	46.768	3.18	639	27190.9	46.895	1.01	699	30004.9	46.877	-1.79
580	24427.1	46.772	3.15	640	27237.8	46.896	0.97	700	30051.7	46.875	-1.85
581	24473.9	46.775	3.11	641	27284.7	46.896	0.93	701	30098.6	46.873	-1.91
582	24520.7	46.778	3.07	642	27331.6	46.897	0.89	702	30145.5	46.871	-1.97
583	24567.5	46.781	3.04	643	27378.5	46.898	0.85	703	30192.4	46.869	-2.03
584	24614.2	46.784	3.00	644	27425.4	46.899	0.81	704	30239.2	46.867	-2.09
585	24661.0	46.787	2.96	645	27472.3	46.900	0.77	705	30286.1	46.865	-2.16
586	24707.8	46.790	2.93	646	27519.2	46.901	0.73	706	30333.0	46.863	-2.22
587	24754.6	46.793	2.89	647	27566.1	46.901	0.69	707	30379.8	46.861	-2.28
588	24801.4	46.796	2.86	648	27613.0	46.902	0.65	708	30426.7	46.858	-2.35
589	24848.2	46.798	2.82	649	27659.9	46.903	0.61	709	30473.5	46.856	-2.41
590	24895.0	46.801	2.78	650	27706.8	46.903	0.57	710	30520.4	46.854	-2.48
591	24941.8	46.804	2.75	651	27753.7	46.904	0.53	711	30567.2	46.851	-2.54
592	24988.6	46.807	2.71	652	27800.6	46.904	0.49	712	30614.1	46.849	-2.61
593	25035.4	46.809	2.68	653	27847.5	46.905	0.45	713	30660.9	46.846	-2.68
594	25082.2	46.812	2.64	654	27894.4	46.905	0.41	714	30707.8	46.843	-2.74
595	25129.0	46.815	2.60	655	27941.3	46.906	0.37	715	30754.6	46.840	-2.81
596	25175.8	46.817	2.57	656	27988.2	46.906	0.33	716	30801.5	46.838	-2.88
597	25222.7	46.820	2.53	657	28035.1	46.906	0.29	717	30848.3	46.835	-2.95
598	25269.5	46.822	2.50	658	28082.0	46.907	0.24	718	30895.1	46.832	-3.02
599	25316.3	46.825	2.46	659	28128.9	46.907	0.20	719	30942.0	46.829	-3.09
600	25363.1	46.827	2.42	660	28175.8	46.907	0.16	720	30988.8	46.826	-3.17

TABLE 6.5.2. *Platinum, Pt-67, versus Type JN thermoelements—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0°C —Continued*

T °C	E μV	S $\mu\text{V}/^\circ\text{C}$	dS/dT $\text{nV}/^\circ\text{C}^2$	T °C	E μV	S $\mu\text{V}/^\circ\text{C}$	dS/dT $\text{nV}/^\circ\text{C}^2$	T °C	E μV	S $\mu\text{V}/^\circ\text{C}$	dS/dT $\text{nV}/^\circ\text{C}^2$
720	30988.8	46.826	-3.17	735	31690.8	46.769	-4.34	750	32391.8	46.694	-5.71
721	31035.6	46.822	-3.24	736	31737.6	46.765	-4.42	751	32438.5	46.689	-5.81
722	31082.4	46.819	-3.31	737	31784.3	46.761	-4.51	752	32485.2	46.683	-5.91
723	31129.3	46.816	-3.39	738	31831.1	46.756	-4.60	753	32531.8	46.677	-6.01
724	31176.1	46.812	-3.46	739	31877.8	46.751	-4.68	754	32578.5	46.671	-6.11
725	31222.9	46.809	-3.54	740	31924.6	46.747	-4.77	755	32625.2	46.665	-6.21
726	31269.7	46.805	-3.61	741	31971.3	46.742	-4.86	756	32671.8	46.658	-6.32
727	31316.5	46.802	-3.69	742	32018.1	46.737	-4.95	757	32718.5	46.652	-6.42
728	31363.3	46.798	-3.77	743	32064.8	46.732	-5.04	758	32765.2	46.645	-6.53
729	31410.1	46.794	-3.85	744	32111.5	46.727	-5.13	759	32811.8	46.639	-6.64
730	31456.9	46.790	-3.93	745	32158.2	46.722	-5.23	760	32858.4	46.632	-6.75
731	31503.7	46.786	-4.01	746	32205.0	46.716	-5.32				
732	31550.5	46.782	-4.09	747	32251.7	46.711	-5.42				
733	31597.2	46.778	-4.17	748	32298.4	46.706	-5.51				
734	31644.0	46.774	-4.25	749	32345.1	46.700	-5.61				
735	31690.8	46.769	-4.34	750	32391.8	46.694	-5.71				

TABLE 6.5.3. *Thermoelectric values at the fixed points for platinum, Pt-67, versus Type JN thermoelements*

Fixed point	Temp. °C	E μV	S $\mu V/^{\circ}C$	dS/dT $nV/^{\circ}C^2$
Nitrogen TP	-210.002	-5535.4	19.429	76.07
Nitrogen NBP	-195.802	-5251.9	20.490	73.47
Oxygen NBP	-182.962	-4982.8	21.419	71.32
Carbon Dioxide SP	-78.476	-2381.8	28.147	58.57
Mercury FP	-38.862	-1221.8	30.394	54.92
Ice point	0.000	0.0	32.462	51.52
Ether TP	26.870	890.6	33.815	49.18
Water BP	100.000	3489.2	37.171	42.51
Benzoic TP	122.370	4331.2	38.098	40.36
Indium FP	156.634	5659.6	39.423	36.96
Tin FP	231.9681	8727.1	41.917	29.20
Bismuth FP	271.442	10403.4	42.989	25.13
Cadmium FP	321.108	12567.4	44.113	20.19
Lead FP	327.502	12849.9	44.240	19.57
Mercury BP	356.660	14147.8	44.771	16.87
Zinc FP	419.580	16994.6	45.665	11.69
Sulphur BP	444.674	18144.0	45.936	9.92
Cu-Al FP	548.23	22943.0	46.652	4.38
Antimony FP	630.74	26803.6	46.885	1.32
Aluminum FP	660.37	28193.2	46.907	0.14

TABLE 6.5.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of platinum, Pt-67, versus Type JN thermoelements*

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-210 to -100 °C	7	4	0.3	<0.1	<0.1	<0.1
-100 to 0 °C	7	2	0.1	<0.1	<0.1	<0.1
0 to 200 °C	7	3	0.2	<0.1	<0.1	<0.1
200 to 400 °C	7	5	0.3	<0.1	<0.1	<0.1
400 to 600 °C	7	6	0.5	<0.1	<0.1	<0.1
600 to 760 °C	7	8	0.6	<0.1	<0.1	<0.1

7. TYPE K—Nickel—Chromium Alloy Versus Nickel—Aluminum Alloy Thermocouples

7.1. Material Specifications and Precautions

This type is more resistant to oxidation at elevated temperatures than the Types E, J or T thermocouples and consequently it finds wide application at temperatures above 500 °C. The positive thermoelement, KP, which is the same as EP, is an alloy that typically contains about 89 to 90 percent nickel, 9 to nearly 9.5 percent chromium, both silicon and iron in amounts up to about 0.5 percent, plus smaller amounts of other constituents such as carbon, manganese, cobalt and niobium. The negative thermoelement, KN, is typically composed of about 95 to 96 percent nickel, 1 to 1.5 percent silicon, 1 to 2.3 percent aluminum, 1.6 to 3.2 percent manganese, up to about 0.5 percent cobalt and smaller amounts of other constituents such as iron, copper and lead. Type KN thermoelements with modified compositions are also available for use in special applications. These include alloys in which the manganese and aluminum contents are reduced or eliminated, while the silicon and cobalt contents are increased.

Type K thermocouples were developed in 1906 and were known originally as "Chromel"¹ versus "Alumel"¹ thermocouples. The Hoskins Manufacturing Company was the sole manufacturer of these thermocouples in this country until the mid-1940's. After this time other Type K thermocouples such as Topel² versus Nial², T₁³ versus T₂³, and ThermoKanthal KP⁴ versus ThermoKanthal KN⁴ were introduced commercially.

The first reference tables for Type K thermocouples to gain general industry-wide acceptance were the ones prepared by Roeser et al. in 1935. They based their tables upon the calibrations of 30 samples of No. 8 AWG Type KP and Type KN thermoelements, except that below 0 °C they used only two samples each of the KP and KN thermoelements. The thermoelements were all furnished by the Hoskins Manufacturing Co. (the only manufacturer at the time), and they were selected by the manufacturer from 100 production tests. The tabular values of Roeser et al. [1935] were corrected by Shenker et al. [1951 and 1955] to account for changes in the temperature scales and electrical units and presented in NBS Circular 561.

Extensive research on the subzero properties of Type K thermocouples was performed by members of the Cryogenics Division in Boulder. That research was summarized and tabulated by Sparks et al. [1972] in NBS Monograph 124. While they found the Type E thermocouple to be the most satisfactory of the standardized letter-designated type thermocouples for measurements down to liquid hydrogen temperature (20.28 K), Type K thermocouples may also be used at these temperatures. However, their Seebeck coefficient (about 4 $\mu\text{V/K}$ at 20 K) is only about one-half of that of Type E thermocouples. Furthermore, the ther-

moelectric homogeneity of KN thermoelements is generally not quite as good as that of EN thermoelements. Both the KP and the KN thermoelements do have a relatively low thermal conductivity and good resistance to corrosion in moist atmospheres at low temperatures.

Type K thermocouples are recommended by the ASTM [1970] for continuous use at temperatures within the range -250 to 1260 °C in oxidizing or inert atmospheres. Both the KP and the KN thermoelements are subject to oxidation when used in air above about 850 °C, but even so, Type K thermocouples may be used at temperatures up to about 1350 °C for short periods with only small changes in calibration. When oxidation occurs it normally leads to a gradual increase in the thermoelectric voltage with time. The magnitude of the change in the thermoelectric voltage and the physical life of the thermocouple will depend upon such factors as the temperature, time at temperature, diameter of the thermoelements and conditions of use. The thermoelectric instability of Type K thermocouples in air at elevated temperatures has been carefully studied by Dahl [1941], Potts and McElroy [1962], Burley and Ackland [1967] and by Wang et al. [1969] and their work should be consulted for details.

In addition, the ASTM Manual STP 470 [1970] gives the following restrictions on the use of Type K thermocouples:

They should not be used in sulfurous, reducing, or alternately reducing and oxidizing atmospheres unless suitably protected with protecting tubes. They should not be used in vacuum (at high temperatures) for extended times because the chromium in the positive thermoelement vaporizes out of solution and alters the calibration. They should also not be used in atmospheres that promote "green-rot" corrosion (those with low, but not negligible, oxygen content).

Both thermoelements of Type K thermocouples are reasonably stable, thermoelectrically, under neutron irradiation since the resulting changes in their chemical compositions due to transmutation are small. The KN thermoelements are somewhat less stable than the KP thermoelements in that they experience a small increase in the iron content accompanied by a slight decrease in the manganese and cobalt contents.

Neither thermoelement of a Type K thermocouple is very sensitive to minor changes in composition or impurity level because both are already heavily alloyed. Similarly, they are also not extremely sensitive to minor differences in heat treatment (provided that the treatment does not violate any of the restrictions mentioned above). For most general applications they may be used with the heat treatment routinely given by the wire manufacturer. However, when extreme accuracy is sought, the thermoelements may require additional preparatory heat treatments in order to achieve the desired results. Details on this and other phases of the use and behavior of Type K thermocouples are given in the articles by Potts and McElroy [1962], and Burley [1969 and 1971].

¹ Trademark—Hoskins Manufacturing Company.

² Trademark—Wilbur B. Driver Company.

³ Trademark—Driver Harris Company.

⁴ Trademark—Kanthal Corporation.

ASTM Standard E230-72 in the Annual Book of ASTM Standards [1972] specifies that the standard limits of error for Type K commercial thermocouples be ± 2.2 °C between 0 and 277 °C and $\pm \frac{3}{4}$ percent between 277 and 1260 °C. Limits of error are not specified for Type K thermocouples below 0 °C. Type K thermocouples can also be supplied to meet special limits of error, which are equal to one half the standard limits of error given above. The recommended upper temperature limit for protected Type K thermocouples, 1260 °C, applies for AWG 8 (3.3 mm) wire. For smaller wires it decreases to 1093 °C for AWG 14 (1.6 mm), 982 °C for AWG 20 (0.8 mm), and 871 °C for AWG 24 or 28 (0.5 or 0.3 mm).

While limits of error for single-leg thermoelements versus platinum are not given in ASTM Standard E230-72, the Type KP and KN thermoelements are supplied, by common practice, to a voltage tolerance equivalent to one half the tolerance specified for the Type K thermocouple.

7.2. Data Analyses and Comparisons

The fitting functions for Type K thermocouples are based on three sets of data: below 0 °C, the research and equations of Sparks et al. [1972] were used directly; above 0 °C, values from NBS Circular 561, Shenker et al. [1955] were used after being modified to be on the new IPTS-68. Also used for fitting above 0 °C were two representative calibrations from the Temperature Section of the National Bureau of Standards in Gaithersburg. Unfortunately there were no data available for both high- and low-temperature calibrations on the same spool or lot of present-day material. This deficiency leads to difficulties in joining high- and low-temperature calibration curves near 0 °C.

Sparks et al. [1972] based their recommended low temperature values for the positive thermoelement, KP, on a selected wire that was most representative of three wires selected from nine spools made by three different manufacturers. Material from all nine spools was certified by their manufacturers to be within the special limits of error (as listed in the last section) at high temperatures. Similarly, the negative thermoelement, KN, represented the most representative wire from a similar sampling. The wires for both positive and negative thermoelements were selected after completion of careful spot calibration and inhomogeneity tests as described in Monograph 124, Sparks et al. [1972]. Values for the single thermoelements are given versus the platinum reference standard, Pt-67. Thermoelectric values for both thermoelements and the combination were relatively difficult to fit precisely. Values for the positive thermoelement required a 12th degree power series to fit 68 points between about -270 and 0 °C with an imprecision of 0.12 μ V; the negative thermoelement required a 12th degree power series to give 0.13 μ V; and the combination (fit independently), 10th degree for an imprecision of 0.08 μ V. In Monograph 124 the two thermoelements and the total combination were fit independently; for this Monograph equations for the total combination and

for the positive thermoelement were used directly but the negative values were obtained by subtraction, symbolically, $KN = K - KP$. Therefore the equation for KN given in this Monograph will differ very slightly from the °C transformation of the one given in Monograph 124. The difference in calculated values will usually be less than the imprecision of the separate fits, 0.13 μ V.

Representative calibration data on Type K thermocouples are much more sparse above 0 °C than they are below. Some of the data points for Type K were selected from NBS Circular 561, adjusted to the present temperature scale, IPTS-68. The others were taken from two representative calibrations for Type K thermocouples that were furnished by the Temperature Section of the National Bureau of Standards, Gaithersburg. The fitting power series was constrained to have the same values for the thermoelectric voltage and Seebeck coefficient at 0 °C as those obtained from the low temperature equations. A tenth degree equation (with constrained constant and linear term and a three constant exponential term) fit 63 selected key tabular and experimental data points between 0 and 1402 °C with an imprecision of 7.8 μ V. Note that this is almost 100 times greater than for the low temperature fit. The second derivative was not constrained at the join.

Fortunately there was a large amount of good data for the positive thermoelement, KP. The fit was based on 93 data points from three calibrations (selected from a set of 13 calibrations) provided by the Temperature Section of the National Bureau of Standards and from a set of selected values in a widely distributed, but unpublished, NBS thermoelement table [Burns, 1967]. All of the high temperature values had to be adjusted to be on the IPTS-68 and to be referenced to Pt-67. A seventh degree equation, with the constant and linear terms constrained to match the low temperature values, had a fitting imprecision of 6.0 μ V for a range from 0 to 1371 °C.

The values for thermoelectric voltages of Type K thermocouples given in this Monograph were compared to those given by Shenker et al. [1955] in NBS Circular 561, to those given by Sparks et al. [1972], and to four representative calibrations from the Temperature Section of the National Bureau of Standards, Gaithersburg. The deviations are shown in figure 7.2.1. The values from NBS Circular 561 were adjusted to the IPTS-68. Above 0 °C, the deviations between the values in this Monograph and those in NBS Circular 561 are caused primarily by the differences in fitting techniques. Below 0 °C, the deviations are caused primarily by chemical composition changes in the thermoelements. The modern materials are slightly different in some of the minor additives. Similar graphs for the Type KP and KN thermoelements are given in figures 7.2.2 and 7.2.3.

Deviations between values given in this Monograph and those given in NBS Circular 561 are shown more clearly in figure 7.2.4. The earlier values were adjusted to the IPTS-68. The width of the curve indicates the roundoff uncertainty (10 μ V) in the tabular values given in NBS Circular 561.

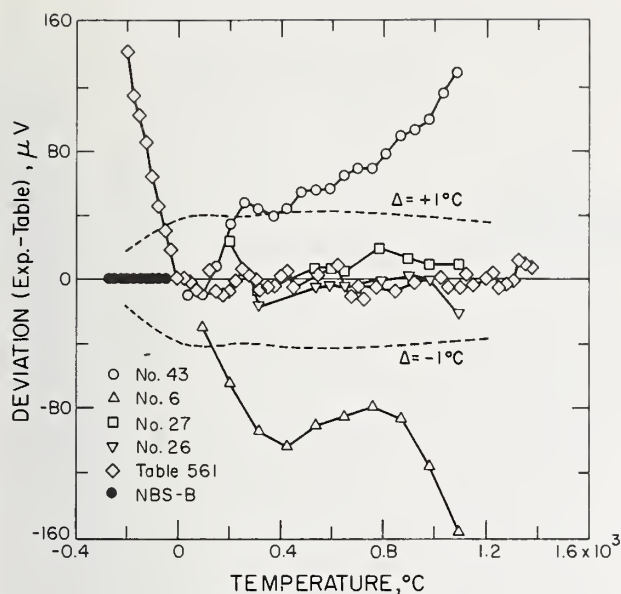


FIGURE 7.2.1. Deviations of thermoelectric voltages of Type K thermocouples—comparison of values given in this Monograph to those given by: Table 561, NBS Circular 561; NBS-B, Sparks, et al. [1972]; Nos. 6, 26, 27, and 43, selected calibrations from the Temperature Section (NBS, Gaithersburg). Values from previous publications and tests are adjusted to the IPTS-68. The dashed lines indicate a deviation of 1 °C.

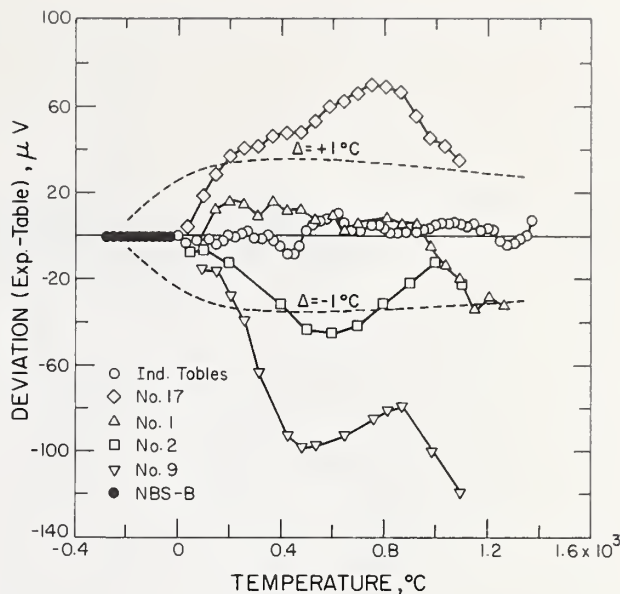


FIGURE 7.2.2. Deviations of thermoelectric voltages of Type KP (or EP) thermoelements versus platinum, Pt-67—comparison of values in this Monograph to those given by: Ind. Tables, unpublished NBS data by Burns [1967]; NBS-B, Sparks, et al. [1972]; Nos. 1, 2, 9 and 17, selected calibrations from the Temperature Section (NBS, Gaithersburg). Values from previous publications and tests are adjusted to the IPTS-68. The dashed lines indicate a deviation of 1 °C.

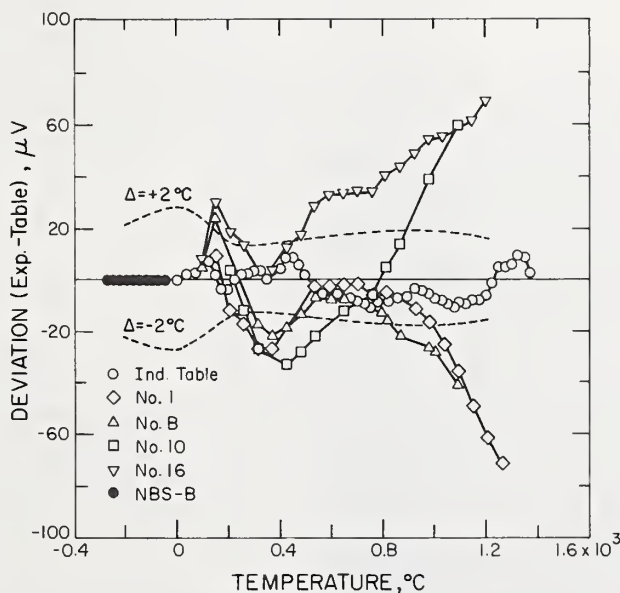


FIGURE 7.2.3. Deviations of the thermoelectric voltages of platinum, Pt-67, versus Type KN thermoelements—comparison of values given in this Monograph to those given by: Ind. Table, unpublished NBS data by Burns [1967]; NBS-B, Sparks, et al. [1972]; Nos. 1, 8, 10, and 16, selected calibrations from the Temperature Section (NBS, Gaithersburg). Values from previous publications and tests are adjusted to the IPTS-68. The dashed lines indicate a deviation of 2 °C.

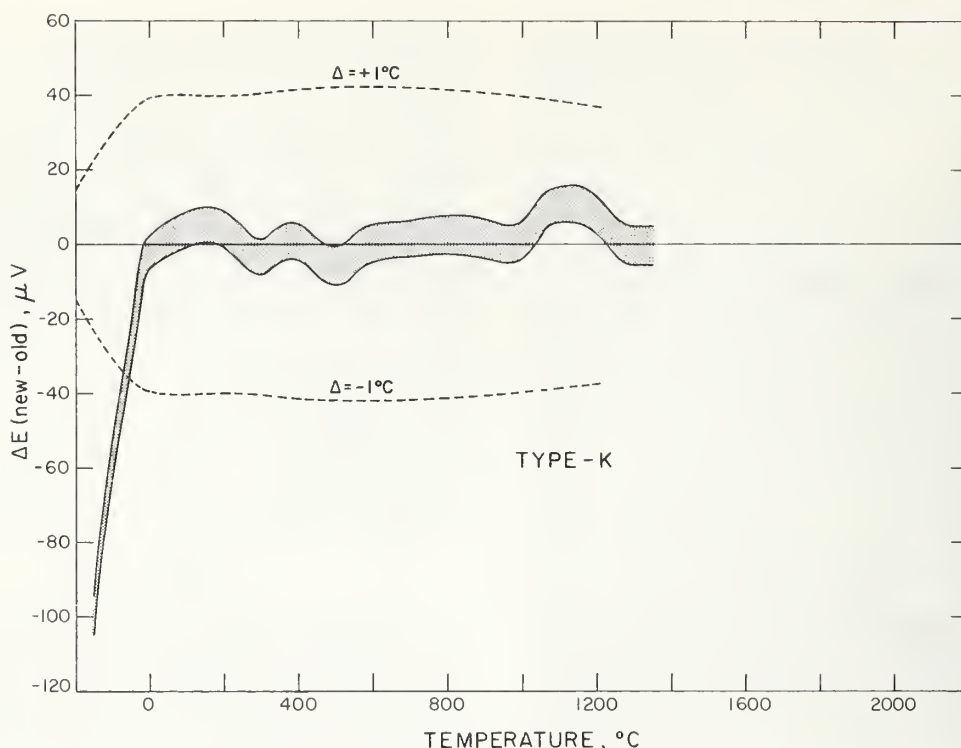


FIGURE 7.2.4. Differences in the thermoelectric voltages for Type K thermocouples—comparison of values given in this Monograph to those given in NBS Circular 561.

The width of the shaded curve indicates the round-off uncertainty in the previous tabular values. Values from NBS Circular 561 are adjusted to the IPTS-68. The dashed lines indicate a deviation of 1 °C.

7.3. Reference Functions and Tables for Type K Thermocouples

The coefficients for the tenth degree expansion for the thermoelectric voltage of Type K thermocouples below 0 °C are given in table 7.3.1. The coefficients for the eighth degree expansion plus an exponential term for use above 0 °C are also given in table 7.3.1. The errors caused by using reduced bit arithmetic for calculating values of the functions are given in table 7.3.4.

The primary reference values for Type K thermocouples are given in table 7.3.2. Values at selected fixed points are given in table 7.3.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 7.3.1, 7.3.2, and 7.3.3, respectively.

It should be stressed that **Type K thermocouple materials that conform closely to the high temperature values may not necessarily conform closely at low temperatures (below 0 °C) and vice versa.** If Type K thermocouples are to be used for accurate measurements both above and below 0 °C, then the material must be calibrated in the full temperature range, both above and below 0 °C. Special selection of material will often be required.

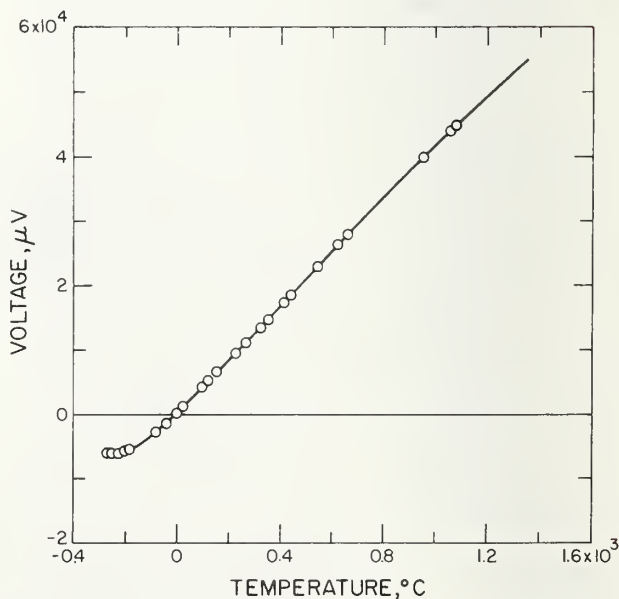


FIGURE 7.3.1. Thermoelectric voltage for Type K thermocouples.

The circles indicate values at various thermometric fixed points on the IPTS-68.

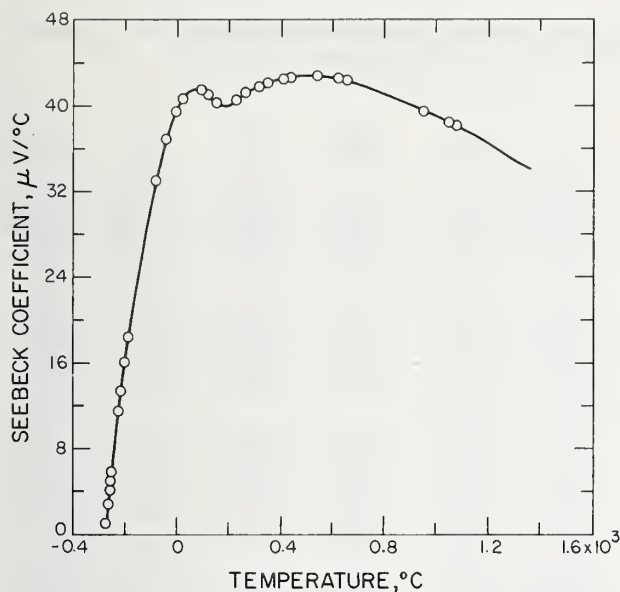


FIGURE 7.3.2. Seebeck coefficient for Type K thermocouples. The circles indicate values at various thermometric fixed points on the IPTS-68.

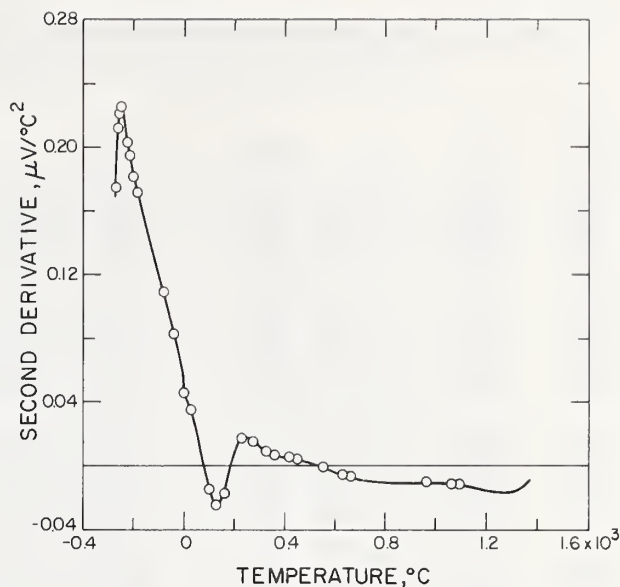


FIGURE 7.3.3. Second derivative of thermoelectric voltage for Type K thermocouples. The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 7.3.1. Power series expansion for the thermoelectric voltage of Type K thermocouples

Temperature range	Degree	Coefficients	Term
-270 to 0 °C	10	3.9475433139×10^1	T
		$2.7465251138 \times 10^{-2}$	T^2
		$-1.6565406716 \times 10^{-4}$	T^3
		$-1.5190912392 \times 10^{-6}$	T^4
		$-2.4581670924 \times 10^{-8}$	T^5
		$-2.4757917816 \times 10^{-10}$	T^6
		$-1.5585276173 \times 10^{-12}$	T^7
		$-5.9729921255 \times 10^{-15}$	T^8
		$-1.2688801216 \times 10^{-19}$	T^9
		$-1.1382797374 \times 10^{-20}$	T^{10}
0 to 1372 °C	8 + exp.	$-1.8533063273 \times 10^1$	...
		3.8918344612×10^1	T
		$1.6645154356 \times 10^{-2}$	T^2
		$-7.8702374448 \times 10^{-5}$	T^3
		$2.2835785557 \times 10^{-7}$	T^4
		$-3.5700231258 \times 10^{-10}$	T^5
		$2.9932909136 \times 10^{-13}$	T^6
		$-1.2849848798 \times 10^{-16}$	T^7
		$2.2239974336 \times 10^{-20}$	T^8
		$+ 125 \exp \left[-\frac{1}{2} \left(\frac{T-127}{65} \right)^2 \right]$	

TABLE 7.3.2. *Type K thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-270	-6457.82	0.739	168.65	-240	-6343.92	7.096	222.90	-210	-6034.63	13.373	193.87
-269	-6456.99	0.911	174.56	-239	-6336.72	7.319	222.30	-209	-6021.16	13.566	192.89
-268	-6455.99	1.088	180.02	-238	-6329.29	7.541	221.63	-208	-6007.49	13.759	191.92
-267	-6454.81	1.270	185.07	-237	-6321.63	7.762	220.91	-207	-5993.64	13.950	190.96
-266	-6453.45	1.458	189.72	-236	-6313.76	7.983	220.14	-206	-5979.59	14.141	190.02
-265	-6451.90	1.650	193.98	-235	-6305.67	8.202	219.32	-205	-5965.36	14.330	189.08
-264	-6450.15	1.846	197.89	-234	-6297.36	8.421	218.47	-204	-5950.93	14.519	188.17
-263	-6448.20	2.045	201.46	-233	-6288.83	8.639	217.57	-203	-5936.32	14.707	187.26
-262	-6446.06	2.248	204.70	-232	-6280.08	8.856	216.65	-202	-5921.52	14.893	186.37
-261	-6443.71	2.455	207.64	-231	-6271.12	9.073	215.70	-201	-5906.53	15.079	185.49
-260	-6441.15	2.664	210.29	-230	-6261.93	9.288	214.72	-200	-5891.36	15.264	184.63
-259	-6438.38	2.875	212.67	-229	-6252.54	9.502	213.72	-199	-5876.00	15.449	183.78
-258	-6435.40	3.089	214.79	-228	-6242.93	9.715	212.70	-198	-5860.46	15.632	182.94
-257	-6432.20	3.305	216.67	-227	-6233.11	9.927	211.67	-197	-5844.74	15.814	182.12
-256	-6428.79	3.522	218.31	-226	-6223.08	10.139	210.62	-196	-5828.84	15.996	181.30
-255	-6425.15	3.741	219.74	-225	-6212.83	10.349	209.57	-195	-5812.75	16.177	180.50
-254	-6421.30	3.962	220.97	-224	-6202.38	10.558	208.51	-194	-5796.48	16.357	179.72
-253	-6417.23	4.183	222.01	-223	-6191.72	10.766	207.44	-193	-5780.03	16.537	178.94
-252	-6412.94	4.406	222.87	-222	-6180.85	10.973	206.37	-192	-5763.41	16.715	178.18
-251	-6408.42	4.629	223.57	-221	-6169.77	11.178	205.30	-191	-5746.61	16.893	177.43
-250	-6403.68	4.853	224.10	-220	-6158.49	11.383	204.23	-190	-5729.62	17.070	176.69
-249	-6398.71	5.077	224.49	-219	-6147.01	11.587	203.17	-189	-5712.47	17.246	175.96
-248	-6393.53	5.302	224.75	-218	-6135.32	11.789	202.10	-188	-5695.13	17.422	175.24
-247	-6388.11	5.526	224.87	-217	-6123.43	11.991	201.04	-187	-5677.62	17.597	174.53
-246	-6382.47	5.751	224.88	-216	-6111.34	12.192	199.99	-186	-5659.94	17.771	173.83
-245	-6376.61	5.976	224.78	-215	-6099.05	12.391	198.95	-185	-5642.08	17.944	173.14
-244	-6370.52	6.201	224.58	-214	-6086.56	12.589	197.91	-184	-5624.05	18.117	172.46
-243	-6364.21	6.425	224.28	-213	-6073.87	12.787	196.89	-183	-5605.85	18.289	171.79
-242	-6357.67	6.649	223.90	-212	-6060.98	12.983	195.87	-182	-5587.47	18.461	171.12
-241	-6350.91	6.873	223.44	-211	-6047.90	13.179	194.86	-181	-5568.92	18.632	170.47
-240	-6343.92	7.096	222.90	-210	-6034.63	13.373	193.87	-180	-5550.21	18.802	169.82

TABLE 7.3.2. *Type K thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-180	-5550.21	18.802	169.82	-120	-4137.85	27.927	134.45	-60	-2242.51	34.872	96.56
-179	-5531.32	18.971	169.18	-119	-4109.86	28.061	133.84	-59	-2207.59	34.968	95.90
-178	-5512.27	19.140	168.54	-118	-4081.73	28.195	133.23	-58	-2172.58	35.064	95.24
-177	-5493.04	19.308	167.91	-117	-4053.47	28.328	132.62	-57	-2137.47	35.159	94.59
-176	-5473.65	19.476	167.29	-116	-4025.08	28.460	132.01	-56	-2102.26	35.253	93.93
-175	-5454.09	19.643	166.67	-115	-3996.55	28.592	131.40	-55	-2066.96	35.347	93.27
-174	-5434.36	19.809	166.06	-114	-3967.89	28.723	130.79	-54	-2031.57	35.439	92.62
-173	-5414.47	19.975	165.45	-113	-3939.10	28.853	130.17	-53	-1996.08	35.532	91.96
-172	-5394.41	20.140	164.85	-112	-3910.19	28.983	129.56	-52	-1960.50	35.623	91.30
-171	-5374.19	20.305	164.25	-111	-3881.14	29.113	128.95	-51	-1924.83	35.714	90.65
-170	-5353.80	20.469	163.66	-110	-3851.96	29.241	128.33	-50	-1889.07	35.805	89.99
-169	-5333.25	20.632	163.06	-109	-3822.66	29.369	127.71	-49	-1853.23	35.894	89.33
-168	-5312.54	20.795	162.47	-108	-3793.22	29.497	127.10	-48	-1817.29	35.983	88.68
-167	-5291.66	20.957	161.89	-107	-3763.66	29.623	126.48	-47	-1781.26	36.072	88.02
-166	-5270.63	21.119	161.31	-106	-3733.98	29.750	125.86	-46	-1745.14	36.159	87.37
-165	-5249.43	21.280	160.72	-105	-3704.16	29.875	125.24	-45	-1708.94	36.246	86.71
-164	-5228.07	21.440	160.15	-104	-3674.23	30.000	124.62	-44	-1672.65	36.333	86.06
-163	-5206.55	21.600	159.57	-103	-3644.16	30.124	124.00	-43	-1636.27	36.419	85.40
-162	-5184.87	21.759	158.99	-102	-3613.98	30.248	123.38	-42	-1599.81	36.504	84.75
-161	-5163.03	21.918	158.42	-101	-3583.67	30.371	122.76	-41	-1563.27	36.588	84.10
-160	-5141.03	22.076	157.85	-100	-3553.23	30.494	122.14	-40	-1526.64	36.672	83.45
-159	-5118.88	22.234	157.27	-99	-3522.68	30.615	121.51	-39	-1489.92	36.755	82.80
-158	-5096.57	22.391	156.70	-98	-3492.00	30.737	120.89	-38	-1453.13	36.837	82.15
-157	-5074.10	22.547	156.13	-97	-3461.21	30.857	120.26	-37	-1416.25	36.919	81.50
-156	-5051.47	22.703	155.56	-96	-3430.29	30.977	119.64	-36	-1379.29	37.000	80.85
-155	-5028.69	22.858	154.99	-95	-3399.25	31.096	119.01	-35	-1342.25	37.081	80.20
-154	-5005.76	23.013	154.42	-94	-3368.10	31.215	118.39	-34	-1305.13	37.161	79.55
-153	-4982.67	23.167	153.85	-93	-3336.82	31.333	117.76	-33	-1267.93	37.240	78.91
-152	-4959.42	23.320	153.27	-92	-3305.43	31.451	117.13	-32	-1230.65	37.319	78.26
-151	-4936.03	23.473	152.70	-91	-3273.92	31.567	116.50	-31	-1193.29	37.397	77.61
-150	-4912.48	23.626	152.13	-90	-3242.30	31.684	115.87	-30	-1155.85	37.474	76.97
-149	-4888.77	23.778	151.56	-89	-3210.55	31.799	115.24	-29	-1118.34	37.551	76.32
-148	-4864.92	23.929	150.98	-88	-3178.70	31.914	114.61	-28	-1080.75	37.627	75.67
-147	-4840.92	24.080	150.41	-87	-3146.73	32.028	113.97	-27	-1043.09	37.702	75.03
-146	-4816.76	24.230	149.83	-86	-3114.64	32.142	113.34	-26	-1005.35	37.777	74.38
-145	-4792.46	24.379	149.26	-85	-3082.44	32.255	112.71	-25	-967.54	37.851	73.73
-144	-4768.00	24.528	148.68	-84	-3050.13	32.368	112.07	-24	-929.65	37.924	73.08
-143	-4743.40	24.677	148.10	-83	-3017.71	32.479	111.43	-23	-891.69	37.997	72.43
-142	-4718.65	24.825	147.52	-82	-2985.17	32.590	110.80	-22	-853.66	38.069	71.77
-141	-4693.75	24.972	146.94	-81	-2952.53	32.701	110.16	-21	-815.55	38.140	71.11
-140	-4668.71	25.118	146.36	-80	-2919.77	32.811	109.52	-20	-777.38	38.211	70.45
-139	-4643.52	25.264	145.77	-79	-2886.91	32.920	108.88	-19	-739.13	38.281	69.79
-138	-4618.18	25.410	145.19	-78	-2853.93	33.028	108.24	-18	-700.81	38.351	69.12
-137	-4592.70	25.555	144.60	-77	-2820.85	33.136	107.60	-17	-662.43	38.419	68.44
-136	-4567.07	25.699	144.01	-76	-2787.66	33.244	106.95	-16	-623.97	38.488	67.76
-135	-4541.30	25.843	143.42	-75	-2754.36	33.350	106.31	-15	-585.45	38.555	67.07
-134	-4515.38	25.986	142.83	-74	-2720.96	33.456	105.67	-14	-546.87	38.622	66.37
-133	-4489.33	26.129	142.24	-73	-2687.45	33.562	105.02	-13	-508.21	38.688	65.66
-132	-4463.13	26.270	141.65	-72	-2653.84	33.666	104.37	-12	-469.49	38.753	64.94
-131	-4436.78	26.412	141.06	-71	-2620.12	33.770	103.73	-11	-430.70	38.818	64.21
-130	-4410.30	26.553	140.46	-70	-2586.30	33.874	103.08	-10	-391.86	38.881	63.47
-129	-4383.68	26.693	139.87	-69	-2552.37	33.977	102.43	-9	-352.94	38.945	62.71
-128	-4356.92	26.832	139.27	-68	-2518.34	34.079	101.78	-8	-313.97	39.007	61.94
-127	-4330.02	26.971	138.67	-67	-2484.21	34.180	101.13	-7	-274.93	39.068	61.15
-126	-4302.97	27.110	138.07	-66	-2449.98	34.281	100.48	-6	-235.83	39.129	60.33
-125	-4275.80	27.247	137.47	-65	-2415.65	34.381	99.83	-5	-196.67	39.189	59.50
-124	-4248.48	27.385	136.87	-64	-2381.22	34.481	99.17	-4	-157.45	39.248	58.64
-123	-4221.03	27.521	136.26	-63	-2346.69	34.579	98.52	-3	-118.17	39.306	57.76
-122	-4193.44	27.657	135.66	-62	-2312.06	34.678	97.86	-2	-78.84	39.364	56.85
-121	-4165.71	27.792	135.05	-61	-2277.34	34.775	97.21	-1	-39.45	39.420	55.91
-120	-4137.85	27.927	134.45	-60	-2242.51	34.872	96.56	0	0.00	39.475	54.93

TABLE 7.3.2. *Type K thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.0	39.475	45.65	60	2435.7	41.407	14.48	120	4919.0	40.969	-23.60
1	39.5	39.521	45.28	61	2477.1	41.421	13.73	121	4959.9	40.946	-23.80
2	79.0	39.566	44.92	62	2518.5	41.434	12.97	122	5000.8	40.922	-23.97
3	118.6	39.611	44.55	63	2560.0	41.447	12.21	123	5041.8	40.898	-24.13
4	158.3	39.655	44.19	64	2601.4	41.458	11.45	124	5082.6	40.874	-24.26
5	197.9	39.699	43.82	65	2642.9	41.470	10.67	125	5123.5	40.849	-24.38
6	237.7	39.743	43.45	66	2684.3	41.480	9.90	126	5164.3	40.825	-24.46
7	277.4	39.786	43.08	67	2725.8	41.489	9.12	127	5205.2	40.800	-24.53
8	317.2	39.829	42.71	68	2767.3	41.498	8.34	128	5245.9	40.776	-24.57
9	357.1	39.871	42.33	69	2808.8	41.506	7.55	129	5286.7	40.751	-24.60
10	397.0	39.914	41.95	70	2850.3	41.513	6.77	130	5327.4	40.727	-24.59
11	436.9	39.955	41.57	71	2891.8	41.520	5.98	131	5368.2	40.702	-24.57
12	476.9	39.997	41.18	72	2933.4	41.525	5.19	132	5408.8	40.678	-24.52
13	516.9	40.038	40.79	73	2974.9	41.530	4.40	133	5449.5	40.653	-24.46
14	557.0	40.078	40.40	74	3016.4	41.534	3.61	134	5490.2	40.629	-24.37
15	597.1	40.118	40.00	75	3058.0	41.537	2.81	135	5530.8	40.604	-24.25
16	637.2	40.158	39.60	76	3099.5	41.540	2.02	136	5571.4	40.580	-24.12
17	677.4	40.198	39.19	77	3141.0	41.541	1.23	137	5611.9	40.556	-23.96
18	717.6	40.237	38.78	78	3182.6	41.542	0.44	138	5652.5	40.532	-23.79
19	757.8	40.275	38.36	79	3224.1	41.542	-0.34	139	5693.0	40.509	-23.59
20	798.1	40.313	37.94	80	3265.7	41.541	-1.12	140	5733.5	40.485	-23.37
21	838.5	40.351	37.51	81	3307.2	41.540	-1.90	141	5774.0	40.462	-23.14
22	878.8	40.388	37.07	82	3348.8	41.538	-2.68	142	5814.4	40.439	-22.88
23	919.3	40.425	36.63	83	3390.3	41.534	-3.45	143	5854.8	40.416	-22.60
24	959.7	40.462	36.18	84	3431.8	41.531	-4.22	144	5895.2	40.394	-22.30
25	1000.2	40.498	35.72	85	3473.3	41.526	-4.98	145	5935.6	40.371	-21.99
26	1040.7	40.533	35.26	86	3514.9	41.521	-5.73	146	5976.0	40.350	-21.65
27	1081.2	40.568	34.79	87	3556.4	41.515	-6.48	147	6016.3	40.328	-21.30
28	1121.8	40.603	34.31	88	3597.9	41.508	-7.21	148	6056.6	40.307	-20.93
29	1162.4	40.637	33.82	89	3639.4	41.500	-7.95	149	6096.9	40.286	-20.55
30	1203.1	40.670	33.33	90	3680.9	41.492	-8.67	150	6137.2	40.266	-20.14
31	1243.8	40.703	32.82	91	3722.4	41.483	-9.38	151	6177.5	40.246	-19.72
32	1284.5	40.736	32.31	92	3763.9	41.473	-10.08	152	6217.7	40.226	-19.29
33	1325.3	40.768	31.79	93	3805.3	41.463	-10.78	153	6257.9	40.207	-18.84
34	1366.0	40.800	31.27	94	3846.8	41.452	-11.46	154	6298.1	40.189	-18.38
35	1406.9	40.831	30.73	95	3888.2	41.440	-12.13	155	6338.3	40.171	-17.90
36	1447.7	40.861	30.18	96	3929.7	41.427	-12.78	156	6378.5	40.153	-17.41
37	1488.6	40.891	29.63	97	3971.1	41.414	-13.43	157	6418.6	40.136	-16.90
38	1529.5	40.920	29.07	98	4012.5	41.400	-14.06	158	6458.7	40.119	-16.39
39	1570.4	40.949	28.49	99	4053.9	41.386	-14.68	159	6498.9	40.103	-15.86
40	1611.4	40.977	27.91	100	4095.3	41.371	-15.28	160	6538.9	40.087	-15.32
41	1652.4	41.005	27.32	101	4136.6	41.356	-15.87	161	6579.0	40.072	-14.77
42	1693.4	41.032	26.72	102	4178.0	41.339	-16.44	162	6619.1	40.058	-14.22
43	1734.4	41.058	26.12	103	4219.3	41.323	-17.00	163	6659.1	40.044	-13.65
44	1775.5	41.084	25.50	104	4260.6	41.305	-17.54	164	6699.2	40.031	-13.07
45	1816.6	41.109	24.87	105	4301.9	41.288	-18.06	165	6739.2	40.018	-12.49
46	1857.7	41.134	24.24	106	4343.2	41.269	-18.57	166	6779.2	40.006	-11.90
47	1898.9	41.158	23.59	107	4384.5	41.250	-19.05	167	6819.2	39.994	-11.30
48	1940.0	41.181	22.94	108	4425.7	41.231	-19.52	168	6859.2	39.983	-10.70
49	1981.2	41.204	22.28	109	4466.9	41.211	-19.97	169	6899.2	39.973	-10.09
50	2022.4	41.226	21.61	110	4508.1	41.191	-20.40	170	6939.2	39.963	-9.47
51	2063.7	41.247	20.93	111	4549.3	41.171	-20.82	171	6979.1	39.954	-8.86
52	2104.9	41.267	20.24	112	4590.5	41.150	-21.21	172	7019.1	39.945	-8.24
53	2146.2	41.287	19.55	113	4631.6	41.128	-21.58	173	7059.0	39.937	-7.61
54	2187.5	41.307	18.85	114	4672.7	41.106	-21.93	174	7098.9	39.930	-6.99
55	2228.8	41.325	18.14	115	4713.8	41.084	-22.26	175	7138.9	39.923	-6.36
56	2270.2	41.343	17.42	116	4754.9	41.062	-22.57	176	7178.8	39.917	-5.73
57	2311.5	41.360	16.69	117	4795.9	41.039	-22.86	177	7218.7	39.912	-5.11
58	2352.9	41.376	15.96	118	4837.0	41.016	-23.13	178	7258.6	39.907	-4.48
59	2394.3	41.392	15.22	119	4878.0	40.993	-23.37	179	7298.5	39.903	-3.85
60	2435.7	41.407	14.48	120	4919.0	40.969	-23.60	180	7338.4	39.899	-3.23

TABLE 7.3.2. *Type K thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	7338.4	39.899	-3.23	240	9745.2	40.542	18.03	300	12207.4	41.459	11.21
181	7378.3	39.896	-2.60	241	9785.7	40.560	18.05	301	12248.9	41.470	11.09
182	7418.2	39.894	-1.98	242	9826.3	40.578	18.05	302	12290.4	41.481	10.96
183	7458.1	39.892	-1.36	243	9866.9	40.596	18.05	303	12331.9	41.492	10.83
184	7498.0	39.891	-0.75	244	9907.5	40.614	18.03	304	12373.4	41.503	10.71
185	7537.9	39.891	-0.14	245	9948.1	40.632	18.01	305	12414.9	41.514	10.59
186	7577.8	39.891	0.46	246	9988.7	40.650	17.98	306	12456.4	41.524	10.47
187	7617.7	39.892	1.06	247	10029.4	40.668	17.95	307	12497.9	41.534	10.35
188	7657.6	39.893	1.66	248	10070.1	40.686	17.90	308	12539.5	41.545	10.24
189	7697.4	39.895	2.24	249	10110.8	40.704	17.85	309	12581.0	41.555	10.13
190	7737.3	39.898	2.82	250	10151.5	40.722	17.80	310	12622.6	41.565	10.02
191	7777.2	39.901	3.40	251	10192.2	40.739	17.73	311	12664.1	41.575	9.91
192	7817.1	39.904	3.96	252	10233.0	40.757	17.66	312	12705.7	41.585	9.80
193	7857.1	39.909	4.52	253	10273.7	40.775	17.58	313	12747.3	41.595	9.70
194	7897.0	39.914	5.07	254	10314.5	40.792	17.50	314	12788.9	41.604	9.60
195	7936.9	39.919	5.61	255	10355.3	40.810	17.41	315	12830.5	41.614	9.50
196	7976.8	39.925	6.14	256	10396.1	40.827	17.32	316	12872.1	41.623	9.40
197	8016.7	39.931	6.67	257	10437.0	40.844	17.22	317	12913.8	41.633	9.30
198	8056.7	39.938	7.18	258	10477.8	40.862	17.12	318	12955.4	41.642	9.21
199	8096.6	39.946	7.68	259	10518.7	40.879	17.01	319	12997.0	41.651	9.12
200	8136.6	39.953	8.17	260	10559.6	40.896	16.90	320	13038.7	41.660	9.03
201	8176.5	39.962	8.66	261	10600.5	40.912	16.78	321	13080.4	41.669	8.94
202	8216.5	39.971	9.13	262	10641.4	40.929	16.66	322	13122.0	41.678	8.86
203	8256.5	39.980	9.59	263	10682.3	40.946	16.53	323	13163.7	41.687	8.77
204	8296.4	39.990	10.03	264	10723.3	40.962	16.41	324	13205.4	41.695	8.69
205	8336.4	40.000	10.47	265	10764.3	40.979	16.28	325	13247.1	41.704	8.61
206	8376.4	40.011	10.89	266	10805.2	40.995	16.14	326	13288.8	41.713	8.53
207	8416.5	40.022	11.31	267	10846.2	41.011	16.01	327	13330.5	41.721	8.46
208	8456.5	40.033	11.71	268	10887.3	41.027	15.87	328	13372.3	41.730	8.38
209	8496.5	40.045	12.09	269	10928.3	41.043	15.73	329	13414.0	41.738	8.31
210	8536.6	40.058	12.47	270	10969.3	41.058	15.59	330	13455.7	41.746	8.24
211	8576.6	40.070	12.83	271	11010.4	41.074	15.44	331	13497.5	41.754	8.17
212	8616.7	40.083	13.18	272	11051.5	41.089	15.30	332	13539.3	41.763	8.11
213	8656.8	40.097	13.52	273	11092.6	41.104	15.15	333	13581.0	41.771	8.04
214	8696.9	40.110	13.85	274	11133.7	41.119	15.00	334	13622.8	41.779	7.98
215	8737.0	40.124	14.16	275	11174.8	41.134	14.85	335	13664.6	41.787	7.92
216	8777.2	40.139	14.46	276	11216.0	41.149	14.70	336	13706.4	41.795	7.86
217	8817.3	40.153	14.75	277	11257.1	41.164	14.55	337	13748.2	41.802	7.80
218	8857.5	40.168	15.02	278	11298.3	41.178	14.40	338	13790.0	41.810	7.74
219	8897.6	40.183	15.28	279	11339.5	41.193	14.25	339	13831.8	41.818	7.68
220	8937.8	40.199	15.53	280	11380.7	41.207	14.09	340	13873.6	41.825	7.63
221	8978.0	40.214	15.77	281	11421.9	41.221	13.94	341	13915.4	41.833	7.58
222	9018.3	40.230	15.99	282	11463.1	41.235	13.79	342	13957.3	41.841	7.52
223	9058.5	40.246	16.21	283	11504.4	41.248	13.64	343	13999.1	41.848	7.47
224	9098.8	40.263	16.40	284	11545.6	41.262	13.49	344	14041.0	41.856	7.43
225	9139.0	40.279	16.59	285	11586.9	41.275	13.34	345	14082.8	41.863	7.38
226	9179.3	40.296	16.77	286	11628.2	41.289	13.19	346	14124.7	41.870	7.33
227	9219.6	40.313	16.93	287	11669.5	41.302	13.04	347	14166.6	41.878	7.29
228	9259.9	40.330	17.08	288	11710.8	41.315	12.89	348	14208.4	41.885	7.24
229	9300.3	40.347	17.22	289	11752.1	41.327	12.74	349	14250.3	41.892	7.20
230	9340.6	40.364	17.35	290	11793.4	41.340	12.60	350	14292.2	41.899	7.16
231	9381.0	40.382	17.46	291	11834.8	41.353	12.45	351	14334.1	41.906	7.11
232	9421.4	40.399	17.57	292	11876.1	41.365	12.31	352	14376.0	41.914	7.07
233	9461.8	40.417	17.66	293	11917.5	41.377	12.17	353	14418.0	41.921	7.04
234	9502.2	40.434	17.75	294	11958.9	41.389	12.02	354	14459.9	41.928	7.00
235	9542.7	40.452	17.82	295	12000.3	41.401	11.88	355	14501.8	41.935	6.96
236	9583.1	40.470	17.88	296	12041.7	41.413	11.75	356	14543.8	41.942	6.92
237	9623.6	40.488	17.93	297	12083.1	41.425	11.61	357	14585.7	41.948	6.89
238	9664.1	40.506	17.98	298	12124.5	41.436	11.48	358	14627.7	41.955	6.85
239	9704.6	40.524	18.01	299	12166.0	41.448	11.34	359	14669.6	41.962	6.82
240	9745.2	40.542	18.03	300	12207.4	41.459	11.21	360	14711.6	41.969	6.78

TABLE 7.3.2. Type K thermocouples—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	14711.6	41.969	6.78	420	17240.9	42.325	5.11	480	19788.4	42.566	2.76
361	14753.6	41.976	6.75	421	17283.2	42.331	5.08	481	19830.9	42.569	2.72
362	14795.5	41.982	6.72	422	17325.6	42.336	5.05	482	19873.5	42.572	2.67
363	14837.5	41.989	6.69	423	17367.9	42.341	5.01	483	19916.1	42.574	2.62
364	14879.5	41.996	6.65	424	17410.2	42.346	4.98	484	19958.6	42.577	2.58
365	14921.5	42.002	6.62	425	17452.6	42.351	4.95	485	20001.2	42.580	2.53
366	14963.5	42.009	6.59	426	17494.9	42.356	4.92	486	20043.8	42.582	2.48
367	15005.5	42.016	6.56	427	17537.3	42.360	4.88	487	20086.4	42.585	2.44
368	15047.5	42.022	6.53	428	17579.7	42.365	4.85	488	20129.0	42.587	2.39
369	15089.6	42.029	6.50	429	17622.0	42.370	4.82	489	20171.6	42.589	2.34
370	15131.6	42.035	6.48	430	17664.4	42.375	4.78	490	20214.1	42.592	2.29
371	15173.6	42.042	6.45	431	17706.8	42.380	4.75	491	20256.7	42.594	2.24
372	15215.7	42.048	6.42	432	17749.2	42.384	4.72	492	20299.3	42.596	2.19
373	15257.7	42.054	6.39	433	17791.5	42.389	4.68	493	20341.9	42.598	2.15
374	15299.8	42.061	6.36	434	17833.9	42.394	4.65	494	20384.5	42.600	2.10
375	15341.9	42.067	6.34	435	17876.3	42.398	4.61	495	20427.1	42.602	2.05
376	15383.9	42.074	6.31	436	17918.7	42.403	4.58	496	20469.7	42.605	2.00
377	15426.0	42.080	6.28	437	17961.1	42.408	4.54	497	20512.3	42.606	1.95
378	15468.1	42.086	6.26	438	18003.6	42.412	4.51	498	20555.0	42.608	1.90
379	15510.2	42.092	6.23	439	18046.0	42.417	4.47	499	20597.6	42.610	1.85
380	15552.3	42.099	6.20	440	18088.4	42.421	4.43	500	20640.2	42.612	1.80
381	15594.4	42.105	6.18	441	18130.8	42.425	4.40	501	20682.8	42.614	1.75
382	15636.5	42.111	6.15	442	18173.2	42.430	4.36	502	20725.4	42.616	1.70
383	15678.6	42.117	6.13	443	18215.7	42.434	4.32	503	20768.0	42.617	1.65
384	15720.7	42.123	6.10	444	18258.1	42.439	4.28	504	20810.6	42.619	1.60
385	15762.8	42.129	6.07	445	18300.5	42.443	4.25	505	20853.3	42.620	1.55
386	15805.0	42.135	6.05	446	18343.0	42.447	4.21	506	20895.9	42.622	1.50
387	15847.1	42.141	6.02	447	18385.4	42.451	4.17	507	20938.5	42.623	1.44
388	15889.3	42.147	6.00	448	18427.9	42.455	4.13	508	20981.1	42.625	1.39
389	15931.4	42.153	5.97	449	18470.3	42.459	4.09	509	21023.7	42.626	1.34
390	15973.6	42.159	5.94	450	18512.8	42.464	4.05	510	21066.4	42.628	1.29
391	16015.7	42.165	5.92	451	18555.3	42.468	4.01	511	21109.0	42.629	1.24
392	16057.9	42.171	5.89	452	18597.7	42.472	3.97	512	21151.6	42.630	1.19
393	16100.1	42.177	5.87	453	18640.2	42.476	3.94	513	21194.3	42.631	1.14
394	16142.2	42.183	5.84	454	18682.7	42.479	3.89	514	21236.9	42.632	1.08
395	16184.4	42.189	5.82	455	18725.2	42.483	3.85	515	21279.5	42.633	1.03
396	16226.6	42.194	5.79	456	18767.7	42.487	3.81	516	21322.2	42.634	0.98
397	16268.8	42.200	5.76	457	18810.2	42.491	3.77	517	21364.8	42.635	0.93
398	16311.0	42.206	5.74	458	18852.6	42.495	3.73	518	21407.4	42.636	0.88
399	16353.2	42.212	5.71	459	18895.1	42.498	3.69	519	21450.1	42.637	0.82
400	16395.4	42.217	5.68	460	18937.6	42.502	3.65	520	21492.7	42.638	0.77
401	16437.7	42.223	5.66	461	18980.1	42.506	3.61	521	21535.3	42.639	0.72
402	16479.9	42.229	5.63	462	19022.7	42.509	3.56	522	21578.0	42.639	0.66
403	16522.1	42.234	5.60	463	19065.2	42.513	3.52	523	21620.6	42.640	0.61
404	16564.4	42.240	5.57	464	19107.7	42.516	3.48	524	21663.3	42.641	0.56
405	16606.6	42.246	5.55	465	19150.2	42.520	3.44	525	21705.9	42.641	0.51
406	16648.9	42.251	5.52	466	19192.7	42.523	3.39	526	21748.5	42.642	0.45
407	16691.1	42.257	5.49	467	19235.2	42.527	3.35	527	21791.2	42.642	0.40
408	16733.4	42.262	5.46	468	19277.8	42.530	3.31	528	21833.8	42.642	0.35
409	16775.6	42.267	5.43	469	19320.3	42.533	3.26	529	21876.5	42.643	0.29
410	16817.9	42.273	5.41	470	19362.8	42.536	3.22	530	21919.1	42.643	0.24
411	16860.2	42.278	5.38	471	19405.4	42.540	3.17	531	21961.8	42.643	0.19
412	16902.5	42.284	5.35	472	19447.9	42.543	3.13	532	22004.4	42.643	0.13
413	16944.7	42.289	5.32	473	19490.5	42.546	3.08	533	22047.0	42.643	0.08
414	16987.0	42.294	5.29	474	19533.0	42.549	3.04	534	22089.7	42.643	0.02
415	17029.3	42.300	5.26	475	19575.6	42.552	2.99	535	22132.3	42.643	-0.03
416	17071.6	42.305	5.23	476	19618.1	42.555	2.95	536	22175.0	42.643	-0.08
417	17113.9	42.310	5.20	477	19660.7	42.558	2.90	537	22217.6	42.643	-0.14
418	17156.3	42.315	5.17	478	19703.2	42.561	2.86	538	22260.3	42.643	-0.19
419	17198.6	42.320	5.14	479	19745.8	42.564	2.81	539	22302.9	42.643	-0.25
420	17240.9	42.325	5.11	480	19788.4	42.566	2.76	540	22345.5	42.643	-0.30

TABLE 7.3.2. Type K thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	22345.5	42.643	-0.30	600	24901.6	42.527	-3.55	660	27445.0	42.224	-6.46
541	22388.2	42.642	-0.35	601	24944.1	42.523	-3.60	661	27487.2	42.217	-6.51
542	22430.8	42.642	-0.41	602	24986.6	42.519	-3.65	662	27529.4	42.211	-6.55
543	22473.5	42.641	-0.46	603	25029.2	42.516	-3.71	663	27571.6	42.204	-6.59
544	22516.1	42.641	-0.52	604	25071.7	42.512	-3.76	664	27613.8	42.197	-6.63
545	22558.8	42.640	-0.57	605	25114.2	42.508	-3.81	665	27656.0	42.191	-6.68
546	22601.4	42.640	-0.63	606	25156.7	42.504	-3.86	666	27698.2	42.184	-6.72
547	22644.0	42.639	-0.68	607	25199.2	42.501	-3.92	667	27740.4	42.177	-6.76
548	22686.7	42.638	-0.74	608	25241.7	42.497	-3.97	668	27782.6	42.170	-6.80
549	22729.3	42.638	-0.79	609	25284.2	42.493	-4.02	669	27824.7	42.164	-6.84
550	22771.9	42.637	-0.84	610	25326.7	42.489	-4.07	670	27866.9	42.157	-6.89
551	22814.6	42.636	-0.90	611	25369.2	42.484	-4.12	671	27909.0	42.150	-6.93
552	22857.2	42.635	-0.95	612	25411.7	42.480	-4.17	672	27951.2	42.143	-6.97
553	22899.9	42.634	-1.01	613	25454.1	42.476	-4.22	673	27993.3	42.136	-7.01
554	22942.5	42.633	-1.06	614	25496.6	42.472	-4.28	674	28035.5	42.129	-7.05
555	22985.1	42.632	-1.12	615	25539.1	42.468	-4.33	675	28077.6	42.122	-7.09
556	23027.8	42.631	-1.17	616	25581.5	42.463	-4.38	676	28119.7	42.115	-7.13
557	23070.4	42.630	-1.23	617	25624.0	42.459	-4.43	677	28161.8	42.108	-7.17
558	23113.0	42.628	-1.28	618	25666.5	42.454	-4.48	678	28203.9	42.100	-7.21
559	23155.6	42.627	-1.34	619	25708.9	42.450	-4.53	679	28246.0	42.093	-7.25
560	23198.3	42.626	-1.39	620	25751.4	42.445	-4.58	680	28288.1	42.086	-7.29
561	23240.9	42.624	-1.45	621	25793.8	42.441	-4.63	681	28330.2	42.079	-7.33
562	23283.5	42.623	-1.50	622	25836.2	42.436	-4.68	682	28372.3	42.071	-7.37
563	23326.1	42.621	-1.55	623	25878.7	42.431	-4.73	683	28414.3	42.064	-7.40
564	23368.8	42.620	-1.61	624	25921.1	42.427	-4.78	684	28456.4	42.056	-7.44
565	23411.4	42.618	-1.66	625	25963.5	42.422	-4.83	685	28498.4	42.049	-7.48
566	23454.0	42.616	-1.72	626	26005.9	42.417	-4.88	686	28540.5	42.041	-7.52
567	23496.6	42.615	-1.77	627	26048.4	42.412	-4.93	687	28582.5	42.034	-7.56
568	23539.2	42.613	-1.83	628	26090.8	42.407	-4.98	688	28624.6	42.026	-7.59
569	23581.8	42.611	-1.88	629	26133.2	42.402	-5.03	689	28666.6	42.019	-7.63
570	23624.4	42.609	-1.94	630	26175.6	42.397	-5.08	690	28708.6	42.011	-7.67
571	23667.1	42.607	-1.99	631	26218.0	42.392	-5.12	691	28750.6	42.003	-7.70
572	23709.7	42.605	-2.05	632	26260.4	42.387	-5.17	692	28792.6	41.996	-7.74
573	23752.3	42.603	-2.10	633	26302.7	42.382	-5.22	693	28834.6	41.988	-7.78
574	23794.9	42.601	-2.15	634	26345.1	42.376	-5.27	694	28876.6	41.980	-7.81
575	23837.5	42.599	-2.21	635	26387.5	42.371	-5.32	695	28918.6	41.972	-7.85
576	23880.1	42.597	-2.26	636	26429.9	42.366	-5.37	696	28960.5	41.964	-7.88
577	23922.7	42.594	-2.32	637	26472.2	42.360	-5.41	697	29002.5	41.957	-7.92
578	23965.3	42.592	-2.37	638	26514.6	42.355	-5.46	698	29044.4	41.949	-7.95
579	24007.8	42.589	-2.43	639	26556.9	42.349	-5.51	699	29086.4	41.941	-7.99
580	24050.4	42.587	-2.48	640	26599.3	42.344	-5.56	700	29128.3	41.933	-8.02
581	24093.0	42.585	-2.53	641	26641.6	42.338	-5.60	701	29170.2	41.925	-8.06
582	24135.6	42.582	-2.59	642	26684.0	42.333	-5.65	702	29212.2	41.917	-8.09
583	24178.2	42.579	-2.64	643	26726.3	42.327	-5.70	703	29254.1	41.908	-8.12
584	24220.8	42.577	-2.70	644	26768.6	42.321	-5.74	704	29296.0	41.900	-8.16
585	24263.3	42.574	-2.75	645	26810.9	42.315	-5.79	705	29337.9	41.892	-8.19
586	24305.9	42.571	-2.80	646	26853.2	42.310	-5.84	706	29379.8	41.884	-8.22
587	24348.5	42.568	-2.86	647	26895.5	42.304	-5.88	707	29421.6	41.876	-8.26
588	24391.0	42.565	-2.91	648	26937.9	42.298	-5.93	708	29463.5	41.867	-8.29
589	24433.6	42.563	-2.96	649	26980.1	42.292	-5.97	709	29505.4	41.859	-8.32
590	24476.2	42.560	-3.02	650	27022.4	42.286	-6.02	710	29547.2	41.851	-8.35
591	24518.7	42.556	-3.07	651	27064.7	42.280	-6.06	711	29589.1	41.842	-8.39
592	24561.3	42.553	-3.13	652	27107.0	42.274	-6.11	712	29630.9	41.834	-8.42
593	24603.8	42.550	-3.18	653	27149.3	42.268	-6.15	713	29672.8	41.826	-8.45
594	24646.4	42.547	-3.23	654	27191.5	42.262	-6.20	714	29714.6	41.817	-8.48
595	24688.9	42.544	-3.28	655	27233.8	42.255	-6.24	715	29756.4	41.809	-8.51
596	24731.5	42.540	-3.34	656	27276.0	42.249	-6.29	716	29798.2	41.800	-8.54
597	24774.0	42.537	-3.39	657	27318.3	42.243	-6.33	717	29840.0	41.791	-8.57
598	24816.5	42.534	-3.44	658	27360.5	42.236	-6.37	718	29881.8	41.783	-8.60
599	24859.1	42.530	-3.50	659	27402.8	42.230	-6.42	719	29923.6	41.774	-8.63
600	24901.6	42.527	-3.55	660	27445.0	42.224	-6.46	720	29965.3	41.766	-8.66

TABLE 7.3.2. *Type K thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	29965.3	41.766	-8.66	780	32454.7	41.202	-9.98	840	34908.5	40.585	-10.47
721	30007.1	41.757	-8.69	781	32495.9	41.192	-9.99	841	34949.1	40.574	-10.48
722	30048.8	41.748	-8.72	782	32537.1	41.182	-10.01	842	34989.7	40.564	-10.48
723	30090.6	41.740	-8.75	783	32578.3	41.172	-10.02	843	35030.2	40.553	-10.48
724	30132.3	41.731	-8.78	784	32619.5	41.162	-10.03	844	35070.8	40.543	-10.48
725	30174.0	41.722	-8.81	785	32660.6	41.152	-10.05	845	35111.3	40.532	-10.49
726	30215.8	41.713	-8.83	786	32701.8	41.142	-10.06	846	35151.8	40.522	-10.49
727	30257.5	41.704	-8.86	787	32742.9	41.132	-10.07	847	35192.3	40.512	-10.49
728	30299.2	41.695	-8.89	788	32784.0	41.122	-10.09	848	35232.8	40.501	-10.49
729	30340.9	41.687	-8.92	789	32825.2	41.112	-10.10	849	35273.3	40.491	-10.49
730	30382.5	41.678	-8.94	790	32866.3	41.102	-10.11	850	35313.8	40.480	-10.49
731	30424.2	41.669	-8.97	791	32907.4	41.091	-10.12	851	35354.3	40.470	-10.49
732	30465.9	41.660	-9.00	792	32948.4	41.081	-10.14	852	35394.8	40.459	-10.50
733	30507.5	41.651	-9.02	793	32989.5	41.071	-10.15	853	35435.2	40.449	-10.50
734	30549.2	41.642	-9.05	794	33030.6	41.061	-10.16	854	35475.7	40.438	-10.50
735	30590.8	41.633	-9.07	795	33071.6	41.051	-10.17	855	35516.1	40.428	-10.50
736	30632.4	41.623	-9.10	796	33112.7	41.041	-10.18	856	35556.5	40.417	-10.50
737	30674.1	41.614	-9.13	797	33153.7	41.030	-10.19	857	35596.9	40.407	-10.50
738	30715.7	41.605	-9.15	798	33194.8	41.020	-10.20	858	35637.3	40.396	-10.50
739	30757.3	41.596	-9.17	799	33235.8	41.010	-10.21	859	35677.7	40.386	-10.50
740	30798.9	41.587	-9.20	800	33276.8	41.000	-10.22	860	35718.1	40.375	-10.50
741	30840.4	41.578	-9.22	801	33317.8	40.990	-10.23	861	35758.5	40.365	-10.50
742	30882.0	41.568	-9.25	802	33358.8	40.979	-10.24	862	35798.8	40.354	-10.50
743	30923.6	41.559	-9.27	803	33399.7	40.969	-10.25	863	35839.2	40.344	-10.50
744	30965.1	41.550	-9.30	804	33440.7	40.959	-10.26	864	35879.5	40.333	-10.50
745	31006.7	41.541	-9.32	805	33481.6	40.949	-10.27	865	35919.8	40.323	-10.50
746	31048.2	41.531	-9.34	806	33522.6	40.938	-10.28	866	35960.2	40.312	-10.50
747	31089.7	41.522	-9.36	807	33563.5	40.928	-10.29	867	36000.5	40.302	-10.50
748	31131.3	41.513	-9.39	808	33604.4	40.918	-10.30	868	36040.8	40.291	-10.49
749	31172.8	41.503	-9.41	809	33645.4	40.907	-10.31	869	36081.1	40.281	-10.49
750	31214.3	41.494	-9.43	810	33686.3	40.897	-10.32	870	36121.3	40.270	-10.49
751	31255.8	41.484	-9.45	811	33727.2	40.887	-10.32	871	36161.6	40.260	-10.49
752	31297.2	41.475	-9.47	812	33768.0	40.876	-10.33	872	36201.8	40.249	-10.49
753	31338.7	41.465	-9.50	813	33808.9	40.866	-10.34	873	36242.1	40.239	-10.49
754	31380.2	41.456	-9.52	814	33849.8	40.856	-10.35	874	36282.3	40.228	-10.49
755	31421.6	41.446	-9.54	815	33890.6	40.845	-10.35	875	36322.5	40.218	-10.49
756	31463.1	41.437	-9.56	816	33931.5	40.835	-10.36	876	36362.8	40.207	-10.48
757	31504.5	41.427	-9.58	817	33972.3	40.825	-10.37	877	36403.0	40.197	-10.48
758	31545.9	41.418	-9.60	818	34013.1	40.814	-10.37	878	36443.2	40.186	-10.48
759	31587.3	41.408	-9.62	819	34053.9	40.804	-10.38	879	36483.3	40.176	-10.48
760	31628.7	41.398	-9.64	820	34094.7	40.794	-10.39	880	36523.5	40.165	-10.48
761	31670.1	41.389	-9.66	821	34135.5	40.783	-10.39	881	36563.7	40.155	-10.47
762	31711.5	41.379	-9.68	822	34176.3	40.773	-10.40	882	36603.8	40.144	-10.47
763	31752.9	41.369	-9.69	823	34217.0	40.762	-10.40	883	36644.0	40.134	-10.47
764	31794.2	41.360	-9.71	824	34257.8	40.752	-10.41	884	36684.1	40.123	-10.47
765	31835.6	41.350	-9.73	825	34298.6	40.742	-10.41	885	36724.2	40.113	-10.47
766	31876.9	41.340	-9.75	826	34339.3	40.731	-10.42	886	36764.3	40.102	-10.46
767	31918.3	41.330	-9.77	827	34380.0	40.721	-10.42	887	36804.4	40.092	-10.46
768	31959.6	41.321	-9.79	828	34420.7	40.710	-10.43	888	36844.5	40.082	-10.46
769	32000.9	41.311	-9.80	829	34461.4	40.700	-10.43	889	36884.6	40.071	-10.46
770	32042.2	41.301	-9.82	830	34502.1	40.689	-10.44	890	36924.6	40.061	-10.45
771	32083.5	41.291	-9.84	831	34542.8	40.679	-10.44	891	36964.7	40.050	-10.45
772	32124.8	41.281	-9.85	832	34583.5	40.669	-10.45	892	37004.7	40.040	-10.45
773	32166.1	41.271	-9.87	833	34624.2	40.658	-10.45	893	37044.8	40.029	-10.44
774	32207.4	41.262	-9.89	834	34664.8	40.648	-10.45	894	37084.8	40.019	-10.44
775	32248.6	41.252	-9.90	835	34705.4	40.637	-10.46	895	37124.8	40.008	-10.44
776	32289.9	41.242	-9.92	836	34746.1	40.627	-10.46	896	37164.8	39.998	-10.44
777	32331.1	41.232	-9.93	837	34786.7	40.616	-10.46	897	37204.8	39.987	-10.43
778	32372.3	41.222	-9.95	838	34827.3	40.606	-10.47	898	37244.8	39.977	-10.43
779	32413.5	41.212	-9.96	839	34867.9	40.595	-10.47	899	37284.8	39.967	-10.43
780	32454.7	41.202	-9.98	840	34908.5	40.585	-10.47	900	37324.7	39.956	-10.42

TABLE 7.3.2. *Type K thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	37324.7	39.956	-10.42	960	39703.4	39.337	-10.25	1020	42045.2	38.719	-10.43
901	37364.7	39.946	-10.42	961	39742.8	39.326	-10.25	1021	42083.9	38.709	-10.43
902	37404.6	39.935	-10.42	962	39782.1	39.316	-10.25	1022	42122.6	38.698	-10.44
903	37444.5	39.925	-10.41	963	39821.4	39.306	-10.25	1023	42161.3	38.688	-10.45
904	37484.5	39.915	-10.41	964	39860.7	39.296	-10.25	1024	42200.0	38.677	-10.46
905	37524.4	39.904	-10.41	965	39900.0	39.285	-10.25	1025	42238.6	38.667	-10.47
906	37564.3	39.894	-10.40	966	39939.3	39.275	-10.24	1026	42277.3	38.656	-10.48
907	37604.2	39.883	-10.40	967	39978.6	39.265	-10.24	1027	42315.9	38.646	-10.49
908	37644.0	39.873	-10.40	968	40017.8	39.255	-10.24	1028	42354.6	38.636	-10.50
909	37683.9	39.863	-10.39	969	40057.1	39.244	-10.24	1029	42393.2	38.625	-10.51
910	37723.8	39.852	-10.39	970	40096.3	39.234	-10.24	1030	42431.8	38.614	-10.52
911	37763.6	39.842	-10.39	971	40135.5	39.224	-10.24	1031	42470.4	38.604	-10.53
912	37803.4	39.831	-10.38	972	40174.7	39.214	-10.24	1032	42509.0	38.593	-10.54
913	37843.3	39.821	-10.38	973	40214.0	39.203	-10.24	1033	42547.6	38.583	-10.55
914	37883.1	39.811	-10.38	974	40253.2	39.193	-10.24	1034	42586.2	38.572	-10.56
915	37922.9	39.800	-10.37	975	40292.3	39.183	-10.24	1035	42624.8	38.562	-10.57
916	37962.7	39.790	-10.37	976	40331.5	39.173	-10.24	1036	42663.3	38.551	-10.58
917	38002.5	39.779	-10.37	977	40370.7	39.162	-10.24	1037	42701.9	38.541	-10.59
918	38042.2	39.769	-10.36	978	40409.8	39.152	-10.25	1038	42740.4	38.530	-10.61
919	38082.0	39.759	-10.36	979	40449.0	39.142	-10.25	1039	42778.9	38.519	-10.62
920	38121.8	39.748	-10.36	980	40488.1	39.132	-10.25	1040	42817.5	38.509	-10.63
921	38161.5	39.738	-10.35	981	40527.3	39.121	-10.25	1041	42856.0	38.498	-10.64
922	38201.2	39.728	-10.35	982	40566.4	39.111	-10.25	1042	42894.5	38.487	-10.66
923	38241.0	39.717	-10.35	983	40605.5	39.101	-10.25	1043	42932.9	38.477	-10.67
924	38280.7	39.707	-10.34	984	40644.6	39.091	-10.25	1044	42971.4	38.466	-10.68
925	38320.4	39.697	-10.34	985	40683.7	39.080	-10.26	1045	43009.9	38.455	-10.70
926	38360.1	39.686	-10.34	986	40722.7	39.070	-10.26	1046	43048.3	38.445	-10.71
927	38399.7	39.676	-10.33	987	40761.8	39.060	-10.26	1047	43086.8	38.434	-10.73
928	38439.4	39.666	-10.33	988	40800.9	39.050	-10.26	1048	43125.2	38.423	-10.74
929	38479.1	39.655	-10.33	989	40839.9	39.039	-10.26	1049	43163.6	38.413	-10.75
930	38518.7	39.645	-10.32	990	40878.9	39.029	-10.27	1050	43202.0	38.402	-10.77
931	38558.4	39.635	-10.32	991	40918.0	39.019	-10.27	1051	43240.4	38.391	-10.78
932	38598.0	39.624	-10.32	992	40957.0	39.009	-10.27	1052	43278.8	38.380	-10.80
933	38637.6	39.614	-10.31	993	40996.0	38.998	-10.28	1053	43317.2	38.369	-10.81
934	38677.2	39.604	-10.31	994	41035.0	38.988	-10.28	1054	43355.5	38.359	-10.83
935	38716.8	39.593	-10.31	995	41074.0	38.978	-10.28	1055	43393.9	38.348	-10.85
936	38756.4	39.583	-10.30	996	41112.9	38.967	-10.29	1056	43432.2	38.337	-10.86
937	38796.0	39.573	-10.30	997	41151.9	38.957	-10.29	1057	43470.6	38.326	-10.88
938	38835.6	39.563	-10.30	998	41190.8	38.947	-10.29	1058	43508.9	38.315	-10.90
939	38875.1	39.552	-10.29	999	41229.8	38.937	-10.30	1059	43547.2	38.304	-10.91
940	38914.7	39.542	-10.29	1000	41268.7	38.926	-10.30	1060	43585.5	38.293	-10.93
941	38954.2	39.532	-10.29	1001	41307.6	38.916	-10.31	1061	43623.8	38.282	-10.95
942	38993.7	39.521	-10.29	1002	41346.5	38.906	-10.31	1062	43662.1	38.271	-10.96
943	39033.2	39.511	-10.28	1003	41385.4	38.895	-10.31	1063	43700.3	38.260	-10.98
944	39072.7	39.501	-10.28	1004	41424.3	38.885	-10.32	1064	43738.6	38.249	-11.00
945	39112.2	39.491	-10.28	1005	41463.2	38.875	-10.32	1065	43776.8	38.238	-11.02
946	39151.7	39.480	-10.28	1006	41502.1	38.864	-10.33	1066	43815.1	38.227	-11.04
947	39191.2	39.470	-10.27	1007	41540.9	38.854	-10.34	1067	43853.3	38.216	-11.06
948	39230.7	39.460	-10.27	1008	41579.8	38.844	-10.34	1068	43891.5	38.205	-11.07
949	39270.1	39.449	-10.27	1009	41618.6	38.833	-10.35	1069	43929.7	38.194	-11.09
950	39309.6	39.439	-10.27	1010	41657.5	38.823	-10.35	1070	43967.9	38.183	-11.11
951	39349.0	39.429	-10.27	1011	41696.3	38.813	-10.36	1071	44006.0	38.172	-11.13
952	39388.4	39.419	-10.26	1012	41735.1	38.802	-10.37	1072	44044.2	38.161	-11.15
953	39427.8	39.408	-10.26	1013	41773.9	38.792	-10.37	1073	44082.4	38.150	-11.17
954	39467.2	39.398	-10.26	1014	41812.7	38.782	-10.38	1074	44120.5	38.139	-11.19
955	39506.6	39.388	-10.26	1015	41851.4	38.771	-10.39	1075	44158.6	38.127	-11.21
956	39546.0	39.378	-10.26	1016	41890.2	38.761	-10.39	1076	44196.8	38.116	-11.24
957	39585.4	39.367	-10.25	1017	41929.0	38.750	-10.40	1077	44234.9	38.105	-11.26
958	39624.8	39.357	-10.25	1018	41967.7	38.740	-10.41	1078	44273.0	38.094	-11.28
959	39664.1	39.347	-10.25	1019	42006.4	38.730	-10.42	1079	44311.1	38.082	-11.30
960	39703.4	39.337	-10.25	1020	42045.2	38.719	-10.43	1080	44349.1	38.071	-11.32

TABLE 7.3.2. *Type K thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1080	44349.1	38.071	-11.32	1140	46612.1	37.344	-13.03	1200	48828.0	36.499	-15.12
1081	44387.2	38.060	-11.34	1141	46649.4	37.331	-13.06	1201	48864.5	36.484	-15.16
1082	44425.3	38.048	-11.37	1142	46686.8	37.318	-13.10	1202	48901.0	36.469	-15.19
1083	44463.3	38.037	-11.39	1143	46724.1	37.305	-13.13	1203	48937.5	36.454	-15.22
1084	44501.3	38.025	-11.41	1144	46761.4	37.292	-13.17	1204	48973.9	36.438	-15.25
1085	44539.4	38.014	-11.44	1145	46798.7	37.278	-13.20	1205	49010.3	36.423	-15.29
1086	44577.4	38.003	-11.46	1146	46835.9	37.265	-13.23	1206	49046.8	36.408	-15.32
1087	44615.4	37.991	-11.48	1147	46873.2	37.252	-13.27	1207	49083.2	36.392	-15.35
1088	44653.3	37.980	-11.51	1148	46910.4	37.239	-13.30	1208	49119.5	36.377	-15.38
1089	44691.3	37.968	-11.53	1149	46947.7	37.225	-13.34	1209	49155.9	36.362	-15.41
1090	44729.3	37.957	-11.55	1150	46984.9	37.212	-13.37	1210	49192.3	36.346	-15.44
1091	44767.2	37.945	-11.58	1151	47022.1	37.199	-13.41	1211	49228.6	36.331	-15.47
1092	44805.2	37.933	-11.60	1152	47059.3	37.185	-13.44	1212	49264.9	36.315	-15.50
1093	44843.1	37.922	-11.63	1153	47096.5	37.172	-13.48	1213	49301.2	36.300	-15.53
1094	44881.0	37.910	-11.65	1154	47133.6	37.158	-13.51	1214	49337.5	36.284	-15.56
1095	44918.9	37.899	-11.68	1155	47170.8	37.145	-13.55	1215	49373.8	36.269	-15.59
1096	44956.8	37.887	-11.70	1156	47207.9	37.131	-13.58	1216	49410.1	36.253	-15.62
1097	44994.7	37.875	-11.73	1157	47245.0	37.118	-13.62	1217	49446.3	36.238	-15.65
1098	45032.6	37.863	-11.76	1158	47282.2	37.104	-13.65	1218	49482.5	36.222	-15.67
1099	45070.4	37.852	-11.78	1159	47319.3	37.090	-13.69	1219	49518.8	36.206	-15.70
1100	45108.3	37.840	-11.81	1160	47356.3	37.077	-13.73	1220	49555.0	36.190	-15.73
1101	45146.1	37.828	-11.84	1161	47393.4	37.063	-13.76	1221	49591.1	36.175	-15.76
1102	45183.9	37.816	-11.86	1162	47430.5	37.049	-13.80	1222	49627.3	36.159	-15.78
1103	45221.7	37.804	-11.89	1163	47467.5	37.035	-13.83	1223	49663.5	36.143	-15.81
1104	45259.5	37.792	-11.92	1164	47504.5	37.021	-13.87	1224	49699.6	36.127	-15.83
1105	45297.3	37.780	-11.94	1165	47541.5	37.007	-13.90	1225	49735.7	36.111	-15.86
1106	45335.1	37.768	-11.97	1166	47578.5	36.994	-13.94	1226	49771.8	36.096	-15.88
1107	45372.9	37.756	-12.00	1167	47615.5	36.980	-13.97	1227	49807.9	36.080	-15.91
1108	45410.6	37.744	-12.03	1168	47652.5	36.966	-14.01	1228	49844.0	36.064	-15.93
1109	45448.3	37.732	-12.06	1169	47689.5	36.952	-14.05	1229	49880.0	36.048	-15.96
1110	45486.1	37.720	-12.09	1170	47726.4	36.937	-14.08	1230	49916.1	36.032	-15.98
1111	45523.8	37.708	-12.11	1171	47763.3	36.923	-14.12	1231	49952.1	36.016	-16.00
1112	45561.5	37.696	-12.14	1172	47800.3	36.909	-14.15	1232	49988.1	36.000	-16.02
1113	45599.2	37.684	-12.17	1173	47837.2	36.895	-14.19	1233	50024.1	35.984	-16.04
1114	45636.9	37.672	-12.20	1174	47874.0	36.881	-14.22	1234	50060.1	35.968	-16.07
1115	45674.5	37.660	-12.23	1175	47910.9	36.867	-14.26	1235	50096.0	35.952	-16.09
1116	45712.2	37.647	-12.26	1176	47947.8	36.852	-14.30	1236	50132.0	35.936	-16.11
1117	45749.8	37.635	-12.29	1177	47984.6	36.838	-14.33	1237	50167.9	35.919	-16.13
1118	45787.4	37.623	-12.32	1178	48021.5	36.824	-14.37	1238	50203.8	35.903	-16.14
1119	45825.1	37.610	-12.35	1179	48058.3	36.809	-14.40	1239	50239.7	35.887	-16.16
1120	45862.7	37.598	-12.38	1180	48095.1	36.795	-14.44	1240	50275.6	35.871	-16.18
1121	45900.3	37.586	-12.41	1181	48131.9	36.780	-14.47	1241	50311.4	35.855	-16.20
1122	45937.8	37.573	-12.44	1182	48168.6	36.766	-14.51	1242	50347.3	35.839	-16.21
1123	45975.4	37.561	-12.48	1183	48205.4	36.751	-14.54	1243	50383.1	35.822	-16.23
1124	46013.0	37.548	-12.51	1184	48242.1	36.737	-14.58	1244	50418.9	35.806	-16.25
1125	46050.5	37.536	-12.54	1185	48278.9	36.722	-14.61	1245	50454.7	35.790	-16.26
1126	46088.0	37.523	-12.57	1186	48315.6	36.708	-14.65	1246	50490.5	35.774	-16.28
1127	46125.5	37.511	-12.60	1187	48352.3	36.693	-14.68	1247	50526.3	35.757	-16.29
1128	46163.1	37.498	-12.63	1188	48389.0	36.678	-14.72	1248	50562.0	35.741	-16.30
1129	46200.5	37.485	-12.67	1189	48425.6	36.663	-14.75	1249	50597.8	35.725	-16.31
1130	46238.0	37.473	-12.70	1190	48462.3	36.649	-14.79	1250	50633.5	35.708	-16.33
1131	46275.5	37.460	-12.73	1191	48498.9	36.634	-14.82	1251	50669.2	35.692	-16.34
1132	46312.9	37.447	-12.76	1192	48535.6	36.619	-14.86	1252	50704.9	35.676	-16.35
1133	46350.4	37.434	-12.80	1193	48572.2	36.604	-14.89	1253	50740.5	35.659	-16.36
1134	46387.8	37.422	-12.83	1194	48608.8	36.589	-14.92	1254	50776.2	35.643	-16.36
1135	46425.2	37.409	-12.86	1195	48645.4	36.574	-14.96	1255	50811.8	35.627	-16.37
1136	46462.6	37.396	-12.90	1196	48681.9	36.559	-14.99	1256	50847.4	35.610	-16.38
1137	46500.0	37.383	-12.93	1197	48718.5	36.544	-15.03	1257	50883.0	35.594	-16.38
1138	46537.4	37.370	-12.96	1198	48755.0	36.529	-15.06	1258	50918.6	35.578	-16.39
1139	46574.8	37.357	-13.00	1199	48791.5	36.514	-15.09	1259	50954.2	35.561	-16.40
1140	46612.1	37.344	-13.03	1200	48828.0	36.499	-15.12	1260	50989.7	35.545	-16.40

TABLE 7.3.2. Type K thermocouples—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1260	50989.7	35.545	-16.40	1300	52398.5	34.897	-15.71	1340	53782.4	34.319	-12.64
1261	51025.3	35.528	-16.40	1301	52433.4	34.881	-15.67	1341	53816.7	34.307	-12.52
1262	51060.8	35.512	-16.40	1302	52468.2	34.865	-15.62	1342	53851.0	34.294	-12.40
1263	51096.3	35.496	-16.41	1303	52503.1	34.850	-15.58	1343	53885.3	34.282	-12.28
1264	51131.8	35.479	-16.41	1304	52537.9	34.834	-15.53	1344	53919.6	34.270	-12.15
1265	51167.3	35.463	-16.41	1305	52572.8	34.819	-15.48	1345	53953.8	34.258	-12.03
1266	51202.7	35.446	-16.40	1306	52607.6	34.803	-15.43	1346	53988.1	34.246	-11.90
1267	51238.2	35.430	-16.40	1307	52642.4	34.788	-15.38	1347	54022.3	34.234	-11.76
1268	51273.6	35.414	-16.40	1308	52677.2	34.772	-15.33	1348	54056.6	34.222	-11.63
1269	51309.0	35.397	-16.39	1309	52711.9	34.757	-15.27	1349	54090.8	34.211	-11.49
1270	51344.4	35.381	-16.39	1310	52746.7	34.742	-15.21	1350	54125.0	34.199	-11.35
1271	51379.7	35.364	-16.38	1311	52781.4	34.727	-15.16	1351	54159.2	34.188	-11.21
1272	51415.1	35.348	-16.38	1312	52816.1	34.711	-15.10	1352	54193.4	34.177	-11.06
1273	51450.4	35.332	-16.37	1313	52850.8	34.696	-15.03	1353	54227.5	34.166	-10.91
1274	51485.8	35.315	-16.36	1314	52885.5	34.681	-14.97	1354	54261.7	34.155	-10.76
1275	51521.1	35.299	-16.35	1315	52920.2	34.666	-14.90	1355	54295.8	34.144	-10.61
1276	51556.4	35.283	-16.34	1316	52954.8	34.652	-14.84	1356	54330.0	34.134	-10.45
1277	51591.6	35.266	-16.32	1317	52989.5	34.637	-14.77	1357	54364.1	34.123	-10.30
1278	51626.9	35.250	-16.31	1318	53024.1	34.622	-14.70	1358	54398.2	34.113	-10.13
1279	51662.1	35.234	-16.30	1319	53058.7	34.607	-14.63	1359	54432.3	34.103	-9.97
1280	51697.4	35.217	-16.28	1320	53093.3	34.593	-14.55	1360	54466.4	34.093	-9.80
1281	51732.6	35.201	-16.26	1321	53127.9	34.578	-14.47	1361	54500.5	34.084	-9.63
1282	51767.8	35.185	-16.25	1322	53162.5	34.564	-14.40	1362	54534.6	34.074	-9.46
1283	51802.9	35.169	-16.23	1323	53197.1	34.549	-14.32	1363	54568.7	34.065	-9.28
1284	51838.1	35.152	-16.21	1324	53231.6	34.535	-14.23	1364	54602.7	34.055	-9.11
1285	51873.2	35.136	-16.19	1325	53266.1	34.521	-14.15	1365	54636.8	34.046	-8.92
1286	51908.4	35.120	-16.16	1326	53300.6	34.507	-14.06	1366	54670.8	34.038	-8.74
1287	51943.5	35.104	-16.14	1327	53335.1	34.493	-13.98	1367	54704.9	34.029	-8.55
1288	51978.6	35.088	-16.12	1328	53369.6	34.479	-13.89	1368	54738.9	34.021	-8.36
1289	52013.7	35.072	-16.09	1329	53404.1	34.465	-13.79	1369	54772.9	34.012	-8.17
1290	52048.7	35.055	-16.06	1330	53438.6	34.451	-13.70	1370	54806.9	34.004	-7.97
1291	52083.8	35.039	-16.03	1331	53473.0	34.438	-13.60	1371	54840.9	33.996	-7.77
1292	52118.8	35.023	-16.00	1332	53507.4	34.424	-13.51	1372	54874.9	33.989	-7.57
1293	52153.8	35.007	-15.97	1333	53541.8	34.411	-13.41				
1294	52188.8	34.991	-15.94	1334	53576.2	34.397	-13.30				
1295	52223.8	34.976	-15.90	1335	53610.6	34.384	-13.20				
1296	52258.8	34.960	-15.87	1336	53645.0	34.371	-13.09				
1297	52293.7	34.944	-15.83	1337	53679.4	34.358	-12.98				
1298	52328.7	34.928	-15.79	1338	53713.7	34.345	-12.87				
1299	52363.6	34.912	-15.75	1339	53748.1	34.332	-12.76				
1300	52398.5	34.897	-15.71	1340	53782.4	34.319	-12.64				

TABLE 7.3.3. *Thermoelectric values at the fixed points for Type K thermocouples*

Fixed point	Temp. °C	<i>E</i> μV	<i>S</i> μV/°C	<i>dS/dT</i> nV/°C ²
Helium NBP	-268.935	-6456.93	0.922	174.92
Hydrogen TP	-259.340	-6439.34	2.803	211.89
Hydrogen NBP	-252.870	-6416.69	4.212	222.13
Neon TP	-248.595	-6396.64	5.168	224.61
Neon NBP	-246.048	-6382.75	5.741	224.89
Oxygen TP	-218.789	-6144.56	11.630	202.94
Nitrogen TP	-210.002	-6034.65	13.373	193.87
Nitrogen NBP	-195.802	-5825.66	16.032	181.14
Oxygen NBP	-182.962	-5605.15	18.296	171.76
Carbon Dioxide SP	-78.476	-2869.64	32.977	108.54
Mercury FP	-38.862	-1484.85	36.766	82.71
Ice point*	0.000	0.00	39.475	45.65
Ether TP	26.870	1076.0	40.564	34.85
Water BP	100.000	4095.3	41.371	-15.28
Benzoic TP	122.370	5016.0	40.913	-24.04
Indium FP	156.634	6403.9	40.142	-17.09
Tin FP	231.9681	9420.1	40.399	17.57
Bismuth FP	271.442	11028.6	41.081	15.38
Cadmium FP	321.108	13084.9	41.670	8.93
Lead FP	327.502	13351.5	41.725	8.42
Mercury BP	356.660	14571.4	41.946	6.90
Zinc FP	419.580	17223.1	42.323	5.12
Sulphur BP	444.674	18286.7	42.441	4.26
Cu-Al FP	548.23	22696.5	42.638	-0.75
Antimony FP	630.74	26207.0	42.393	-5.11
Aluminum FP	660.37	27460.6	42.221	-6.48
Silver FP	961.93	39779.4	39.317	-10.25
Gold FP	1064.43	43755.0	38.245	-11.01
Copper FP	1084.5	44520.4	38.020	-11.42

*Junction point of different functions.

TABLE 7.3.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type K thermocouples*

Temperature range	Degree	Estimated maximum error in micro volts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-270 to -200 °C	10	15	1	<0.01	<0.01	<0.01
-200 to 0 °C	10	2	0.1	<0.01	<0.01	<0.01
0 to 200 °C	8 + exp	3	0.2	<0.01	<0.01	<0.01
200 to 400 °C	8 + exp	3	0.6	<0.01	<0.01	<0.01
400 to 600 °C	8 + exp	14	2	<0.01	<0.01	<0.01
600 to 800 °C	8 + exp	50	3	0.02	<0.01	<0.01
800 to 1000 °C	8 + exp	130	4	0.06	<0.01	<0.01
1000 to 1200 °C	8 + exp	300	4	0.2	0.02	<0.01
1200 to 1372 °C	8 + exp	500	20	0.4	0.04	<0.01

7.4. Reference Functions and Tables for the Positive Thermoelement, Type KP, a Nickel-Chromium Alloy Versus Platinum, Pt-67

The coefficients for the twelfth degree expansion for the thermoelectric voltage of Type KP (or EP) thermoelements versus Pt-67 below 0 °C are given in table 7.4.1. The coefficients for the sixth degree expansion above 0 °C are also given in table 7.4.1. The errors caused by using reduced bit arithmetic for calculating values of the functions are given in table 7.4.4.

The primary reference values for Type KP (or EP) thermoelements versus Pt-67 are given in table 7.4.2. Values at selected fixed points are given in table 7.4.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 7.4.1, 7.4.2, and 7.4.3, respectively.

It should be stressed that **Type KP (or EP) thermoelement material that conforms closely to the high temperature tabular values may not necessarily conform closely at low temperatures (below 0 °C) and vice versa.** If Type KP (or EP) thermoelements are to be used for accurate measurements both above and below 0 °C, then the material must be calibrated in the full temperature range, both above and below 0 °C. Special selection of material will often be required.

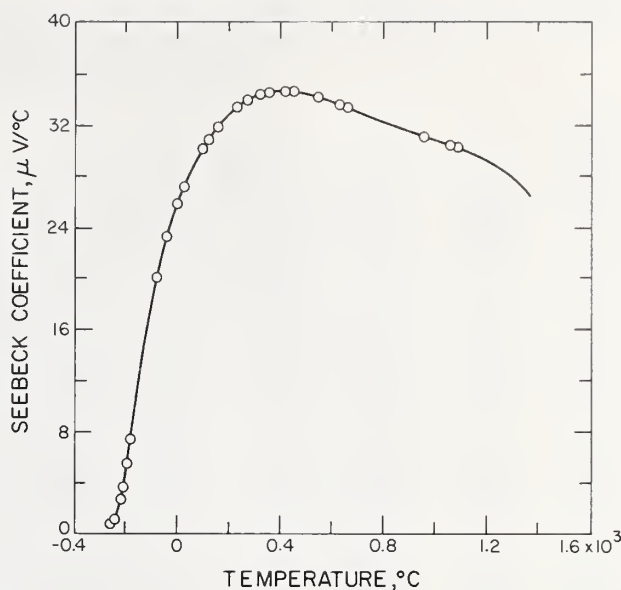


FIGURE 7.4.2. Seebeck coefficient for Type KP (or EP) thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

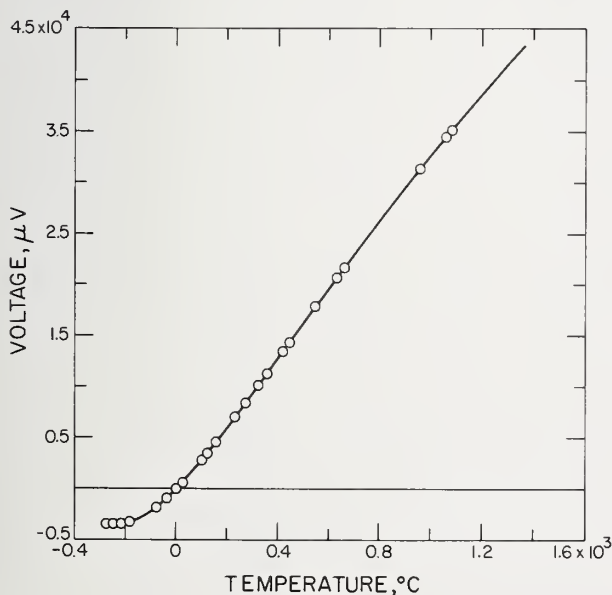


FIGURE 7.4.1. Thermoelectric voltage for Type KP (or EP) thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

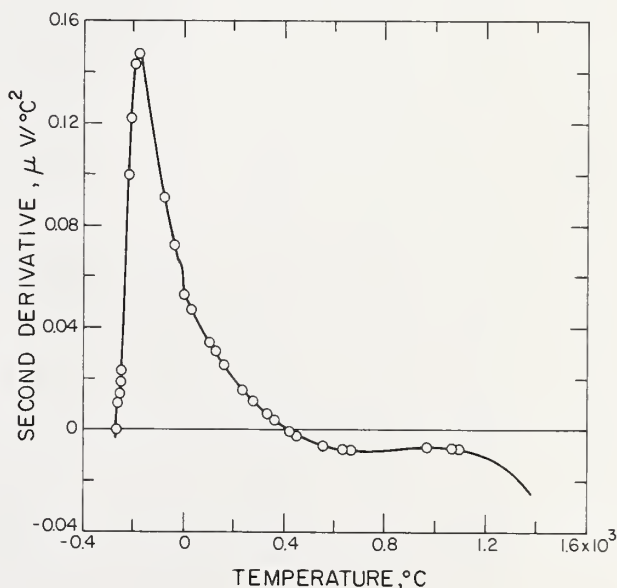


FIGURE 7.4.3. Second derivative of thermoelectric voltage for Type KP (or EP) thermoelements versus platinum, Pt-67. The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 7.4.1. *Power series expansion for the thermoelectric voltage of Type KP (or EP) thermoelements versus platinum, Pt-67*

Temperature range	Degree	Coefficients	Term
-270 to 0 °C	12	2.5835710133×10^1	T
		$2.7202146415 \times 10^{-2}$	T^2
		$-3.8345637644 \times 10^{-4}$	T^3
		$-1.6841065632 \times 10^{-5}$	T^4
		$-4.4654164515 \times 10^{-7}$	T^5
		$-7.0161464011 \times 10^{-9}$	T^6
		$-7.0114175503 \times 10^{-11}$	T^7
		$-4.5711262093 \times 10^{-13}$	T^8
		$-1.9366901505 \times 10^{-15}$	T^9
		$-5.1348097562 \times 10^{-18}$	T^{10}
		$-7.7268515186 \times 10^{-21}$	T^{11}
		$-5.0290738536 \times 10^{-24}$	T^{12}
0 to 1372 °C	6	2.5835710133×10^1	T
		$2.6122152288 \times 10^{-2}$	T^2
		$-3.3553323755 \times 10^{-5}$	T^3
		$1.5901401017 \times 10^{-8}$	T^4
		$-6.0374933939 \times 10^{-13}$	T^5
		$-1.2087501500 \times 10^{-15}$	T^6

TABLE 7.4.2. *Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-270	-3557.78	0.849	-3.36	-240	-3527.94	1.289	35.96	-210	-3459.76	3.701	121.78
-269	-3556.94	0.847	-0.16	-239	-3526.63	1.327	38.58	-209	-3455.99	3.824	123.84
-268	-3556.09	0.849	2.41	-238	-3525.28	1.367	41.30	-208	-3452.11	3.949	125.80
-267	-3555.24	0.852	4.46	-237	-3523.89	1.409	44.11	-207	-3448.10	4.075	127.67
-266	-3554.38	0.857	6.07	-236	-3522.46	1.455	46.99	-206	-3443.96	4.204	129.45
-265	-3553.52	0.864	7.31	-235	-3520.98	1.503	49.95	-205	-3439.69	4.334	131.13
-264	-3552.65	0.872	8.26	-234	-3519.45	1.555	52.97	-204	-3435.29	4.466	132.72
-263	-3551.78	0.880	8.99	-233	-3517.87	1.609	56.04	-203	-3430.76	4.600	134.21
-262	-3550.89	0.890	9.55	-232	-3516.24	1.667	59.15	-202	-3426.09	4.735	135.61
-261	-3550.00	0.900	9.99	-231	-3514.54	1.727	62.29	-201	-3421.29	4.871	136.91
-260	-3549.09	0.910	10.36	-230	-3512.78	1.791	65.45	-200	-3416.35	5.008	138.13
-259	-3548.18	0.920	10.70	-229	-3510.95	1.858	68.63	-199	-3411.27	5.147	139.25
-258	-3547.25	0.931	11.05	-228	-3509.06	1.929	71.81	-198	-3406.05	5.287	140.29
-257	-3546.32	0.942	11.42	-227	-3507.10	2.002	74.99	-197	-3400.69	5.428	141.24
-256	-3545.37	0.954	11.86	-226	-3505.06	2.079	78.15	-196	-3395.20	5.569	142.10
-255	-3544.41	0.966	12.38	-225	-3502.94	2.158	81.29	-195	-3389.56	5.712	142.89
-254	-3543.44	0.979	12.99	-224	-3500.74	2.241	84.41	-194	-3383.77	5.855	143.59
-253	-3542.45	0.992	13.73	-223	-3498.45	2.327	87.49	-193	-3377.84	5.999	144.21
-252	-3541.45	1.006	14.58	-222	-3496.08	2.416	90.53	-192	-3371.77	6.143	144.76
-251	-3540.44	1.021	15.58	-221	-3493.62	2.508	93.52	-191	-3365.56	6.288	145.24
-250	-3539.41	1.037	16.71	-220	-3491.07	2.603	96.45	-190	-3359.20	6.434	145.65
-249	-3538.36	1.055	18.00	-219	-3488.41	2.701	99.33	-189	-3352.69	6.580	145.99
-248	-3537.30	1.074	19.43	-218	-3485.66	2.802	102.13	-188	-3346.04	6.726	146.26
-247	-3536.22	1.094	21.01	-217	-3482.81	2.905	104.87	-187	-3339.24	6.872	146.47
-246	-3535.11	1.116	22.73	-216	-3479.85	3.012	107.54	-186	-3332.29	7.019	146.63
-245	-3533.98	1.139	24.61	-215	-3476.79	3.120	110.12	-185	-3325.20	7.165	146.73
-244	-3532.83	1.165	26.62	-214	-3473.61	3.232	112.63	-184	-3317.96	7.312	146.77
-243	-3531.65	1.193	28.77	-213	-3470.32	3.346	115.05	-183	-3310.58	7.459	146.76
-242	-3530.45	1.222	31.04	-212	-3466.92	3.462	117.38	-182	-3303.04	7.606	146.71
-241	-3529.21	1.255	33.44	-211	-3463.40	3.580	119.63	-181	-3295.36	7.752	146.61
-240	-3527.94	1.289	35.96	-210	-3459.76	3.701	121.78	-180	-3287.54	7.899	146.47

TABLE 7.4.2. *Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-180	-3287.54	7.899	146.47	-120	-2565.84	15.828	114.74	-60	-1431.58	21.658	82.55
-179	-3279.57	8.045	146.29	-119	-2549.96	15.942	114.11	-59	-1409.88	21.741	82.10
-178	-3271.45	8.192	146.07	-118	-2533.96	16.056	113.47	-58	-1388.10	21.823	81.65
-177	-3263.48	8.337	145.82	-117	-2517.84	16.169	112.83	-57	-1366.24	21.904	81.19
-176	-3254.77	8.483	145.53	-116	-2501.62	16.282	112.19	-56	-1344.29	21.985	80.72
-175	-3246.22	8.629	145.22	-115	-2485.28	16.394	111.54	-55	-1322.27	22.065	80.25
-174	-3237.52	8.774	144.87	-114	-2468.83	16.505	110.90	-54	-1300.16	22.145	79.77
-173	-3228.67	8.918	144.51	-113	-2452.27	16.615	110.25	-53	-1277.98	22.225	79.29
-172	-3219.68	9.063	144.11	-112	-2435.60	16.725	109.61	-52	-1255.71	22.304	78.80
-171	-3210.55	9.206	143.70	-111	-2418.82	16.835	108.96	-51	-1233.37	22.383	78.30
-170	-3201.27	9.350	143.27	-110	-2401.93	16.943	108.32	-50	-1210.95	22.461	77.79
-169	-3191.85	9.493	142.82	-109	-2384.93	17.051	107.68	-49	-1188.45	22.538	77.28
-168	-3182.28	9.636	142.35	-108	-2367.83	17.159	107.03	-48	-1165.87	22.615	76.77
-167	-3172.57	9.778	141.87	-107	-2350.62	17.265	106.39	-47	-1143.22	22.692	76.25
-166	-3162.73	9.919	141.38	-106	-2333.30	17.371	105.75	-46	-1120.49	22.768	75.72
-165	-3152.74	10.060	140.87	-105	-2315.87	17.477	105.12	-45	-1097.68	22.843	75.19
-164	-3142.61	10.201	140.36	-104	-2298.35	17.582	104.49	-44	-1074.80	22.918	74.66
-163	-3132.33	10.341	139.83	-103	-2280.71	17.686	103.86	-43	-1051.85	22.992	74.13
-162	-3121.92	10.481	139.30	-102	-2262.97	17.789	103.24	-42	-1028.82	23.066	73.60
-161	-3111.37	10.620	138.76	-101	-2245.13	17.892	102.62	-41	-1005.72	23.140	73.07
-160	-3100.68	10.758	138.22	-100	-2227.19	17.995	102.00	-40	-982.54	23.212	72.55
-159	-3089.86	10.896	137.67	-99	-2209.14	18.096	101.39	-39	-959.29	23.285	72.03
-158	-3078.89	11.034	137.12	-98	-2191.00	18.197	100.79	-38	-935.97	23.357	71.51
-157	-3067.79	11.170	136.56	-97	-2172.75	18.298	100.19	-37	-912.58	23.428	71.01
-156	-3056.55	11.307	136.00	-96	-2154.40	18.398	99.60	-36	-889.12	23.499	70.51
-155	-3045.18	11.442	135.44	-95	-2135.95	18.497	99.02	-35	-865.58	23.569	70.02
-154	-3033.67	11.578	134.87	-94	-2117.41	18.596	98.44	-34	-841.98	23.639	69.55
-153	-3022.02	11.712	134.31	-93	-2098.76	18.694	97.87	-33	-818.31	23.708	69.10
-152	-3010.24	11.846	133.74	-92	-2080.02	18.792	97.31	-32	-794.56	23.777	68.66
-151	-2998.33	11.980	133.17	-91	-2061.18	18.889	96.76	-31	-770.75	23.845	68.24
-150	-2986.28	12.113	132.60	-90	-2042.24	18.985	96.21	-30	-746.87	23.913	67.84
-149	-2974.10	12.245	132.03	-89	-2023.21	19.081	95.68	-29	-722.93	23.981	67.47
-148	-2961.79	12.377	131.46	-88	-2004.08	19.176	95.15	-28	-698.91	24.048	67.12
-147	-2949.35	12.508	130.89	-87	-1984.86	19.271	94.63	-27	-674.83	24.115	66.80
-146	-2936.78	12.638	130.32	-86	-1965.54	19.366	94.11	-26	-650.68	24.182	66.50
-145	-2924.07	12.768	129.74	-85	-1946.13	19.460	93.61	-25	-626.47	24.248	66.23
-144	-2911.24	12.898	129.17	-84	-1926.62	19.553	93.11	-24	-602.18	24.314	65.99
-143	-2898.28	13.027	128.59	-83	-1907.02	19.646	92.62	-23	-577.84	24.380	65.78
-142	-2885.19	13.155	128.02	-82	-1887.33	19.738	92.14	-22	-553.42	24.446	65.59
-141	-2871.97	13.283	127.44	-81	-1867.54	19.830	91.67	-21	-528.95	24.511	65.44
-140	-2858.62	13.410	126.86	-80	-1847.67	19.922	91.20	-20	-504.40	24.577	65.30
-139	-2845.15	13.536	126.28	-79	-1827.70	20.012	90.74	-19	-479.79	24.642	65.19
-138	-2831.55	13.662	125.70	-78	-1807.64	20.103	90.29	-18	-455.12	24.707	65.10
-137	-2817.82	13.788	125.11	-77	-1787.50	20.193	89.84	-17	-430.38	24.772	65.03
-136	-2803.97	13.913	124.52	-76	-1767.26	20.283	89.40	-16	-405.57	24.837	64.96
-135	-2790.00	14.037	123.94	-75	-1746.93	20.372	88.96	-15	-380.70	24.902	64.90
-134	-2775.90	14.161	123.34	-74	-1726.51	20.461	88.53	-14	-355.77	24.967	64.83
-133	-2761.68	14.284	122.75	-73	-1706.01	20.549	88.10	-13	-330.77	25.032	64.75
-132	-2747.33	14.406	122.15	-72	-1685.42	20.637	87.67	-12	-305.71	25.096	64.64
-131	-2732.87	14.528	121.55	-71	-1664.74	20.724	87.25	-11	-280.58	25.161	64.50
-130	-2718.28	14.649	120.95	-70	-1643.97	20.811	86.82	-10	-255.38	25.225	64.30
-129	-2703.57	14.770	120.34	-69	-1623.11	20.898	86.40	-9	-230.13	25.290	64.03
-128	-2688.74	14.890	119.73	-68	-1602.17	20.984	85.98	-8	-204.80	25.353	63.68
-127	-2673.79	15.009	119.12	-67	-1581.14	21.070	85.56	-7	-179.42	25.417	63.21
-126	-2658.72	15.128	118.50	-66	-1560.03	21.155	85.14	-6	-153.97	25.480	62.61
-125	-2643.53	15.246	117.89	-65	-1538.83	21.240	84.71	-5	-128.46	25.542	61.85
-124	-2628.23	15.364	117.26	-64	-1517.55	21.325	84.29	-4	-102.89	25.603	60.89
-123	-2612.81	15.481	116.64	-63	-1496.19	21.409	83.86	-3	-77.25	25.664	59.71
-122	-2597.27	15.597	116.01	-62	-1474.73	21.492	83.43	-2	-51.56	25.723	58.27
-121	-2581.61	15.713	115.38	-61	-1453.20	21.576	82.99	-1	-25.81	25.780	56.51
-120	-2565.84	15.828	114.74	-60	-1431.58	21.658	82.55	0	0.00	25.836	54.40

TABLE 7.4.2. *Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.0	25.836	52.24	60	1637.1	28.622	40.85	120	3421.7	30.765	30.81
1	25.9	25.888	52.04	61	1665.8	28.662	40.67	121	3452.5	30.795	30.65
2	51.8	25.940	51.84	62	1694.5	28.703	40.49	122	3483.3	30.826	30.49
3	77.7	25.992	51.64	63	1723.2	28.743	40.31	123	3514.2	30.856	30.34
4	103.8	26.043	51.44	64	1752.0	28.784	40.14	124	3545.0	30.887	30.18
5	129.8	26.094	51.24	65	1780.8	28.824	39.96	125	3575.9	30.917	30.03
6	155.9	26.146	51.04	66	1809.6	28.864	39.78	126	3606.9	30.947	29.87
7	182.1	26.197	50.84	67	1838.5	28.903	39.61	127	3637.8	30.976	29.72
8	208.3	26.247	50.65	68	1867.4	28.943	39.43	128	3668.8	31.006	29.57
9	234.6	26.298	50.45	69	1896.4	28.982	39.26	129	3699.9	31.036	29.41
10	260.9	26.348	50.25	70	1925.4	29.021	39.08	130	3730.9	31.065	29.26
11	287.3	26.398	50.05	71	1954.4	29.060	38.91	131	3762.0	31.094	29.11
12	313.7	26.448	49.86	72	1983.5	29.099	38.73	132	3793.1	31.123	28.96
13	340.2	26.498	49.66	73	2012.6	29.138	38.56	133	3824.2	31.152	28.80
14	366.7	26.548	49.46	74	2041.8	29.176	38.39	134	3855.4	31.181	28.65
15	393.3	26.597	49.27	75	2071.0	29.215	38.21	135	3886.6	31.209	28.50
16	419.9	26.646	49.07	76	2100.2	29.253	38.04	136	3917.8	31.238	28.35
17	446.6	26.695	48.88	77	2129.5	29.291	37.87	137	3949.1	31.266	28.20
18	473.3	26.744	48.68	78	2158.8	29.328	37.70	138	3980.3	31.294	28.05
19	500.1	26.792	48.49	79	2188.1	29.366	37.52	139	4011.7	31.322	27.90
20	526.9	26.841	48.29	80	2217.5	29.403	37.35	140	4043.0	31.350	27.75
21	553.8	26.889	48.10	81	2246.9	29.441	37.18	141	4074.4	31.378	27.60
22	580.7	26.937	47.91	82	2276.4	29.478	37.01	142	4105.7	31.405	27.46
23	607.6	26.985	47.71	83	2305.9	29.515	36.84	143	4137.2	31.433	27.31
24	634.6	27.032	47.52	84	2335.4	29.551	36.67	144	4168.6	31.460	27.16
25	661.7	27.080	47.33	85	2365.0	29.588	36.50	145	4200.1	31.487	27.01
26	688.8	27.127	47.14	86	2394.6	29.624	36.33	146	4231.6	31.514	26.86
27	716.0	27.174	46.95	87	2424.2	29.661	36.16	147	4263.1	31.541	26.72
28	743.2	27.221	46.76	88	2453.9	29.697	36.00	148	4294.7	31.567	26.57
29	770.4	27.268	46.57	89	2483.6	29.733	35.83	149	4326.2	31.594	26.43
30	797.7	27.314	46.38	90	2513.4	29.768	35.66	150	4357.9	31.620	26.28
31	825.0	27.360	46.19	91	2543.2	29.804	35.49	151	4389.5	31.646	26.14
32	852.4	27.407	46.00	92	2573.0	29.839	35.33	152	4421.1	31.672	25.99
33	879.8	27.452	45.81	93	2602.8	29.875	35.16	153	4452.8	31.698	25.85
34	907.3	27.498	45.62	94	2632.7	29.910	34.99	154	4484.5	31.724	25.70
35	934.8	27.544	45.43	95	2662.7	29.945	34.83	155	4516.3	31.750	25.56
36	962.4	27.589	45.24	96	2692.6	29.979	34.66	156	4548.0	31.775	25.41
37	990.0	27.634	45.06	97	2722.6	30.014	34.50	157	4579.8	31.801	25.27
38	1017.7	27.679	44.87	98	2752.7	30.048	34.33	158	4611.6	31.826	25.13
39	1045.4	27.724	44.68	99	2782.7	30.083	34.17	159	4643.5	31.851	24.99
40	1073.1	27.768	44.50	100	2812.8	30.117	34.00	160	4675.3	31.876	24.84
41	1100.9	27.813	44.31	101	2843.0	30.151	33.84	161	4707.2	31.900	24.70
42	1128.7	27.857	44.12	102	2873.1	30.184	33.68	162	4739.1	31.925	24.56
43	1156.6	27.901	43.94	103	2903.3	30.218	33.52	163	4771.1	31.950	24.42
44	1184.5	27.945	43.75	104	2933.6	30.251	33.35	164	4803.0	31.974	24.28
45	1212.5	27.989	43.57	105	2963.8	30.285	33.19	165	4835.0	31.998	24.14
46	1240.5	28.032	43.39	106	2994.1	30.318	33.03	166	4867.0	32.022	24.00
47	1268.6	28.075	43.20	107	3024.5	30.351	32.87	167	4899.1	32.046	23.86
48	1296.7	28.119	43.02	108	3054.8	30.384	32.71	168	4931.1	32.070	23.72
49	1324.8	28.161	42.84	109	3085.2	30.416	32.55	169	4963.2	32.094	23.58
50	1353.0	28.204	42.65	110	3115.7	30.449	32.39	170	4995.3	32.117	23.44
51	1381.2	28.247	42.47	111	3146.1	30.481	32.23	171	5027.4	32.140	23.31
52	1409.5	28.289	42.29	112	3176.6	30.513	32.07	172	5059.6	32.164	23.17
53	1437.8	28.331	42.11	113	3207.2	30.545	31.91	173	5091.8	32.187	23.03
54	1466.2	28.373	41.93	114	3237.7	30.577	31.75	174	5124.0	32.210	22.89
55	1494.5	28.415	41.75	115	3268.3	30.609	31.59	175	5156.2	32.233	22.76
56	1523.0	28.457	41.57	116	3298.9	30.640	31.43	176	5188.4	32.255	22.62
57	1551.5	28.498	41.39	117	3329.6	30.672	31.28	177	5220.7	32.278	22.49
58	1580.0	28.540	41.21	118	3360.3	30.703	31.12	178	5253.0	32.300	22.35
59	1608.5	28.581	41.03	119	3391.0	30.734	30.96	179	5285.3	32.323	22.22
60	1637.1	28.622	40.85	120	3421.7	30.765	30.81	180	5317.6	32.345	22.08

TABLE 7.4.2. *Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	5317.6	32.345	22.08	240	7293.4	33.440	14.63	300	9322.2	34.125	8.40
181	5350.0	32.367	21.95	241	7326.9	33.454	14.52	301	9356.3	34.133	8.31
182	5382.4	32.389	21.81	242	7360.3	33.469	14.40	302	9390.5	34.141	8.21
183	5414.8	32.410	21.68	243	7393.8	33.483	14.29	303	9424.6	34.150	8.12
184	5447.2	32.432	21.54	244	7427.3	33.497	14.18	304	9458.8	34.158	8.03
185	5479.6	32.453	21.41	245	7460.8	33.512	14.07	305	9492.9	34.166	7.94
186	5512.1	32.475	21.28	246	7494.3	33.526	13.95	306	9527.1	34.174	7.84
187	5544.6	32.496	21.15	247	7527.8	33.539	13.84	307	9561.3	34.181	7.75
188	5577.1	32.517	21.01	248	7561.4	33.553	13.73	308	9595.5	34.189	7.66
189	5609.6	32.538	20.88	249	7594.9	33.567	13.62	309	9629.7	34.197	7.57
190	5642.2	32.559	20.75	250	7628.5	33.581	13.51	310	9663.9	34.204	7.48
191	5674.7	32.580	20.62	251	7662.1	33.594	13.40	311	9698.1	34.212	7.39
192	5707.3	32.600	20.49	252	7695.7	33.607	13.29	312	9732.3	34.219	7.30
193	5739.9	32.621	20.36	253	7729.3	33.621	13.18	313	9766.5	34.226	7.21
194	5772.6	32.641	20.23	254	7763.0	33.634	13.07	314	9800.7	34.233	7.12
195	5805.2	32.661	20.10	255	7796.6	33.647	12.96	315	9835.0	34.241	7.03
196	5837.9	32.681	19.97	256	7830.2	33.660	12.85	316	9869.2	34.247	6.94
197	5870.6	32.701	19.84	257	7863.9	33.672	12.75	317	9903.5	34.254	6.85
198	5903.3	32.721	19.71	258	7897.6	33.685	12.64	318	9937.7	34.261	6.76
199	5936.0	32.740	19.59	259	7931.3	33.698	12.53	319	9972.0	34.268	6.67
200	5968.8	32.760	19.46	260	7965.0	33.710	12.42	320	10006.3	34.275	6.59
201	6001.5	32.779	19.33	261	7998.7	33.723	12.32	321	10040.6	34.281	6.50
202	6034.3	32.799	19.20	262	8032.4	33.735	12.21	322	10074.8	34.288	6.41
203	6067.1	32.818	19.08	263	8066.2	33.747	12.10	323	10109.1	34.294	6.32
204	6100.0	32.837	18.95	264	8099.9	33.759	12.00	324	10143.4	34.300	6.24
205	6132.8	32.856	18.82	265	8133.7	33.771	11.89	325	10177.7	34.306	6.15
206	6165.7	32.874	18.70	266	8167.5	33.783	11.79	326	10212.0	34.312	6.07
207	6198.6	32.893	18.57	267	8201.3	33.794	11.68	327	10246.4	34.319	5.98
208	6231.5	32.911	18.45	268	8235.1	33.806	11.58	328	10280.7	34.324	5.89
209	6264.4	32.930	18.32	269	8268.9	33.818	11.47	329	10315.0	34.330	5.81
210	6297.3	32.948	18.20	270	8302.7	33.829	11.37	330	10349.3	34.336	5.72
211	6330.3	32.966	18.08	271	8336.5	33.840	11.26	331	10383.7	34.342	5.64
212	6363.3	32.984	17.95	272	8370.4	33.852	11.16	332	10418.0	34.347	5.56
213	6396.2	33.002	17.83	273	8404.2	33.863	11.06	333	10452.4	34.353	5.47
214	6429.3	33.020	17.71	274	8438.1	33.874	10.96	334	10486.7	34.358	5.39
215	6462.3	33.038	17.58	275	8472.0	33.885	10.85	335	10521.1	34.364	5.31
216	6495.3	33.055	17.46	276	8505.9	33.895	10.75	336	10555.5	34.369	5.22
217	6528.4	33.073	17.34	277	8539.8	33.906	10.65	337	10589.8	34.374	5.14
218	6561.5	33.090	17.22	278	8573.7	33.917	10.55	338	10624.2	34.379	5.06
219	6594.6	33.107	17.10	279	8607.6	33.927	10.45	339	10658.6	34.384	4.98
220	6627.7	33.124	16.98	280	8641.5	33.938	10.35	340	10693.0	34.389	4.89
221	6660.8	33.141	16.86	281	8675.5	33.948	10.25	341	10727.4	34.394	4.81
222	6694.0	33.158	16.74	282	8709.4	33.958	10.15	342	10761.8	34.399	4.73
223	6727.1	33.174	16.62	283	8743.4	33.968	10.05	343	10796.2	34.403	4.65
224	6760.3	33.191	16.50	284	8777.4	33.978	9.95	344	10830.6	34.408	4.57
225	6793.5	33.207	16.38	285	8811.3	33.988	9.85	345	10865.0	34.413	4.49
226	6826.7	33.224	16.26	286	8845.3	33.998	9.75	346	10899.4	34.417	4.41
227	6860.0	33.240	16.14	287	8879.3	34.008	9.65	347	10933.8	34.421	4.33
228	6893.2	33.256	16.02	288	8913.4	34.017	9.55	348	10968.2	34.426	4.25
229	6926.5	33.272	15.90	289	8947.4	34.027	9.46	349	11002.7	34.430	4.17
230	6959.8	33.288	15.79	290	8981.4	34.036	9.36	350	11037.1	34.434	4.10
231	6993.1	33.303	15.67	291	9015.4	34.045	9.26	351	11071.5	34.438	4.02
232	7026.4	33.319	15.55	292	9049.5	34.055	9.16	352	11106.0	34.442	3.94
233	7059.7	33.335	15.44	293	9083.6	34.064	9.07	353	11140.4	34.446	3.86
234	7093.0	33.350	15.32	294	9117.6	34.073	8.97	354	11174.9	34.450	3.78
235	7126.4	33.365	15.20	295	9151.7	34.082	8.88	355	11209.3	34.454	3.71
236	7159.8	33.380	15.09	296	9185.8	34.091	8.78	356	11243.8	34.457	3.63
237	7193.2	33.395	14.97	297	9219.9	34.099	8.69	357	11278.2	34.461	3.55
238	7226.6	33.410	14.86	298	9254.0	34.108	8.59	358	11312.7	34.464	3.48
239	7260.0	33.425	14.75	299	9288.1	34.116	8.50	359	11347.2	34.468	3.40
240	7293.4	33.440	14.63	300	9322.2	34.125	8.40	360	11381.6	34.471	3.33

TABLE 7.4.2. *Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	11381.6	34.471	3.33	420	13453.3	34.546	-0.67	480	15522.9	34.410	-3.69
361	11416.1	34.474	3.25	421	13487.9	34.545	-0.73	481	15557.3	34.406	-3.73
362	11450.6	34.478	3.18	422	13522.4	34.544	-0.79	482	15591.7	34.403	-3.77
363	11485.1	34.481	3.10	423	13557.0	34.543	-0.85	483	15626.1	34.399	-3.81
364	11519.5	34.484	3.03	424	13591.5	34.542	-0.90	484	15660.5	34.395	-3.85
365	11554.0	34.487	2.95	425	13626.0	34.542	-0.96	485	15694.9	34.391	-3.89
366	11588.5	34.490	2.88	426	13660.6	34.541	-1.02	486	15729.3	34.387	-3.94
367	11623.0	34.493	2.81	427	13695.1	34.539	-1.07	487	15763.7	34.383	-3.98
368	11657.5	34.495	2.73	428	13729.7	34.538	-1.13	488	15798.1	34.379	-4.02
369	11692.0	34.498	2.66	429	13764.2	34.537	-1.19	489	15832.4	34.375	-4.06
370	11726.5	34.501	2.59	430	13798.7	34.536	-1.24	490	15866.8	34.371	-4.10
371	11761.0	34.503	2.52	431	13833.3	34.535	-1.30	491	15901.2	34.367	-4.14
372	11795.5	34.506	2.44	432	13867.8	34.533	-1.35	492	15935.5	34.363	-4.18
373	11830.0	34.508	2.37	433	13902.3	34.532	-1.41	493	15969.9	34.359	-4.22
374	11864.5	34.510	2.30	434	13936.9	34.531	-1.46	494	16004.3	34.354	-4.26
375	11899.0	34.513	2.23	435	13971.4	34.529	-1.51	495	16038.6	34.350	-4.30
376	11933.5	34.515	2.16	436	14005.9	34.528	-1.57	496	16073.0	34.346	-4.33
377	11968.1	34.517	2.09	437	14040.5	34.526	-1.62	497	16107.3	34.342	-4.37
378	12002.6	34.519	2.02	438	14075.0	34.524	-1.68	498	16141.6	34.337	-4.41
379	12037.1	34.521	1.95	439	14109.5	34.523	-1.73	499	16176.0	34.333	-4.45
380	12071.6	34.523	1.88	440	14144.0	34.521	-1.78	500	16210.3	34.328	-4.49
381	12106.1	34.525	1.81	441	14178.5	34.519	-1.83	501	16244.6	34.324	-4.52
382	12140.7	34.527	1.74	442	14213.1	34.517	-1.89	502	16279.0	34.319	-4.56
383	12175.2	34.528	1.67	443	14247.6	34.515	-1.94	503	16313.3	34.315	-4.60
384	12209.7	34.530	1.60	444	14282.1	34.513	-1.99	504	16347.6	34.310	-4.64
385	12244.3	34.532	1.53	445	14316.6	34.511	-2.04	505	16381.9	34.305	-4.67
386	12278.8	34.533	1.47	446	14351.1	34.509	-2.09	506	16416.2	34.301	-4.71
387	12313.3	34.534	1.40	447	14385.6	34.507	-2.14	507	16450.5	34.296	-4.75
388	12347.9	34.536	1.33	448	14420.1	34.505	-2.20	508	16484.8	34.291	-4.78
389	12382.4	34.537	1.26	449	14454.6	34.503	-2.25	509	16519.1	34.286	-4.82
390	12416.9	34.538	1.20	450	14489.1	34.500	-2.30	510	16553.4	34.282	-4.85
391	12451.5	34.540	1.13	451	14523.6	34.498	-2.35	511	16587.6	34.277	-4.89
392	12486.0	34.541	1.06	452	14558.1	34.496	-2.40	512	16621.9	34.272	-4.92
393	12520.5	34.542	1.00	453	14592.6	34.493	-2.45	513	16656.2	34.267	-4.96
394	12555.1	34.543	0.93	454	14627.1	34.491	-2.50	514	16690.5	34.262	-4.99
395	12589.6	34.544	0.87	455	14661.6	34.488	-2.54	515	16724.7	34.257	-5.03
396	12624.2	34.544	0.80	456	14696.1	34.486	-2.59	516	16759.0	34.252	-5.06
397	12658.7	34.545	0.74	457	14730.6	34.483	-2.64	517	16793.2	34.247	-5.09
398	12693.3	34.546	0.67	458	14765.1	34.480	-2.69	518	16827.5	34.242	-5.13
399	12727.8	34.546	0.61	459	14799.5	34.478	-2.74	519	16861.7	34.236	-5.16
400	12762.4	34.547	0.55	460	14834.0	34.475	-2.79	520	16895.9	34.231	-5.19
401	12796.9	34.548	0.48	461	14868.5	34.472	-2.83	521	16930.2	34.226	-5.23
402	12831.5	34.548	0.42	462	14903.0	34.469	-2.88	522	16964.4	34.221	-5.26
403	12866.0	34.548	0.36	463	14937.4	34.466	-2.93	523	16998.6	34.216	-5.29
404	12900.6	34.549	0.29	464	14971.9	34.463	-2.97	524	17032.8	34.210	-5.32
405	12935.1	34.549	0.23	465	15006.4	34.461	-3.02	525	17067.0	34.205	-5.36
406	12969.6	34.549	0.17	466	15040.8	34.457	-3.07	526	17101.2	34.200	-5.39
407	13004.2	34.549	0.11	467	15075.3	34.454	-3.11	527	17135.4	34.194	-5.42
408	13038.7	34.549	0.04	468	15109.7	34.451	-3.16	528	17169.6	34.189	-5.45
409	13073.3	34.549	-0.02	469	15144.2	34.448	-3.20	529	17203.8	34.183	-5.48
410	13107.8	34.549	-0.08	470	15178.6	34.445	-3.25	530	17238.0	34.178	-5.51
411	13142.4	34.549	-0.14	471	15213.1	34.442	-3.29	531	17272.2	34.172	-5.54
412	13176.9	34.549	-0.20	472	15247.5	34.438	-3.34	532	17306.3	34.167	-5.58
413	13211.5	34.549	-0.26	473	15281.9	34.435	-3.38	533	17340.5	34.161	-5.61
414	13246.0	34.549	-0.32	474	15316.4	34.431	-3.43	534	17374.6	34.155	-5.64
415	13280.6	34.548	-0.38	475	15350.8	34.428	-3.47	535	17408.8	34.150	-5.67
416	13315.1	34.548	-0.44	476	15385.2	34.425	-3.51	536	17442.9	34.144	-5.69
417	13349.7	34.547	-0.50	477	15419.7	34.421	-3.56	537	17477.1	34.138	-5.72
418	13384.2	34.547	-0.56	478	15454.1	34.417	-3.60	538	17511.2	34.133	-5.75
419	13418.8	34.546	-0.61	479	15488.5	34.414	-3.64	539	17545.4	34.127	-5.78
420	13453.3	34.546	-0.67	480	15522.9	34.410	-3.69	540	17579.5	34.121	-5.81

TABLE 7.4.2. *Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	17579.5	34.121	-5.81	600	19615.4	33.728	-7.16	660	21625.7	33.275	-7.86
541	17613.6	34.115	-5.84	601	19649.1	33.721	-7.18	661	21658.9	33.267	-7.87
542	17647.7	34.109	-5.87	602	19682.8	33.714	-7.19	662	21692.2	33.259	-7.87
543	17681.8	34.104	-5.90	603	19716.5	33.707	-7.21	663	21725.5	33.251	-7.88
544	17715.9	34.098	-5.92	604	19750.2	33.700	-7.23	664	21758.7	33.243	-7.89
545	17750.0	34.092	-5.95	605	19783.9	33.692	-7.24	665	21791.9	33.235	-7.89
546	17784.1	34.086	-5.98	606	19817.6	33.685	-7.26	666	21825.2	33.227	-7.90
547	17818.2	34.080	-6.01	607	19851.3	33.678	-7.27	667	21858.4	33.220	-7.90
548	17852.3	34.074	-6.03	608	19885.0	33.671	-7.29	668	21891.6	33.212	-7.91
549	17886.3	34.068	-6.06	609	19918.6	33.663	-7.30	669	21924.8	33.204	-7.92
550	17920.4	34.062	-6.09	610	19952.3	33.656	-7.32	670	21958.0	33.196	-7.92
551	17954.4	34.055	-6.11	611	19985.9	33.649	-7.33	671	21991.2	33.188	-7.93
552	17988.5	34.049	-6.14	612	20019.6	33.641	-7.35	672	22024.4	33.180	-7.93
553	18022.5	34.043	-6.17	613	20053.2	33.634	-7.36	673	22057.6	33.172	-7.94
554	18056.6	34.037	-6.19	614	20086.8	33.627	-7.38	674	22090.7	33.164	-7.94
555	18090.6	34.031	-6.22	615	20120.5	33.619	-7.39	675	22123.9	33.156	-7.95
556	18124.6	34.025	-6.24	616	20154.1	33.612	-7.41	676	22157.0	33.148	-7.95
557	18158.7	34.018	-6.27	617	20187.7	33.604	-7.42	677	22190.2	33.140	-7.96
558	18192.7	34.012	-6.29	618	20221.3	33.597	-7.43	678	22223.3	33.132	-7.96
559	18226.7	34.006	-6.32	619	20254.9	33.589	-7.45	679	22256.5	33.124	-7.97
560	18260.7	33.999	-6.34	620	20288.5	33.582	-7.46	680	22289.6	33.116	-7.97
561	18294.7	33.993	-6.37	621	20322.1	33.575	-7.47	681	22322.7	33.108	-7.97
562	18328.7	33.987	-6.39	622	20355.6	33.567	-7.49	682	22355.8	33.100	-7.98
563	18362.7	33.980	-6.41	623	20389.2	33.560	-7.50	683	22388.9	33.092	-7.98
564	18396.6	33.974	-6.44	624	20422.7	33.552	-7.51	684	22422.0	33.084	-7.99
565	18430.6	33.967	-6.46	625	20456.3	33.545	-7.52	685	22455.1	33.076	-7.99
566	18464.6	33.961	-6.48	626	20489.8	33.537	-7.54	686	22488.1	33.068	-7.99
567	18498.5	33.954	-6.51	627	20523.4	33.529	-7.55	687	22521.2	33.061	-8.00
568	18532.5	33.948	-6.53	628	20556.9	33.522	-7.56	688	22554.3	33.053	-8.00
569	18566.4	33.941	-6.55	629	20590.4	33.514	-7.57	689	22587.3	33.045	-8.00
570	18600.4	33.935	-6.58	630	20623.9	33.507	-7.58	690	22620.3	33.037	-8.00
571	18634.3	33.928	-6.60	631	20657.4	33.499	-7.60	691	22653.4	33.028	-8.01
572	18668.2	33.922	-6.62	632	20690.9	33.492	-7.61	692	22686.4	33.020	-8.01
573	18702.1	33.915	-6.64	633	20724.4	33.484	-7.62	693	22719.4	33.012	-8.01
574	18736.1	33.908	-6.66	634	20757.9	33.476	-7.63	694	22752.4	33.004	-8.02
575	18770.0	33.902	-6.69	635	20791.4	33.469	-7.64	695	22785.4	32.996	-8.02
576	18803.9	33.895	-6.71	636	20824.8	33.461	-7.65	696	22818.4	32.988	-8.02
577	18837.8	33.888	-6.73	637	20858.3	33.453	-7.66	697	22851.4	32.980	-8.02
578	18871.6	33.882	-6.75	638	20891.7	33.446	-7.67	698	22884.4	32.972	-8.02
579	18905.5	33.875	-6.77	639	20925.2	33.438	-7.68	699	22917.3	32.964	-8.03
580	18939.4	33.868	-6.79	640	20958.6	33.430	-7.69	700	22950.3	32.956	-8.03
581	18973.3	33.861	-6.81	641	20992.0	33.423	-7.70	701	22983.3	32.948	-8.03
582	19007.1	33.854	-6.83	642	21025.5	33.415	-7.71	702	23016.2	32.940	-8.03
583	19041.0	33.848	-6.85	643	21058.9	33.407	-7.72	703	23049.1	32.932	-8.03
584	19074.8	33.841	-6.87	644	21092.3	33.400	-7.73	704	23082.1	32.924	-8.03
585	19108.6	33.834	-6.89	645	21125.7	33.392	-7.74	705	23115.0	32.916	-8.03
586	19142.5	33.827	-6.91	646	21159.0	33.384	-7.75	706	23147.9	32.908	-8.04
587	19176.3	33.820	-6.93	647	21192.4	33.376	-7.76	707	23180.8	32.900	-8.04
588	19210.1	33.813	-6.95	648	21225.8	33.369	-7.77	708	23213.7	32.892	-8.04
589	19243.9	33.806	-6.97	649	21259.2	33.361	-7.77	709	23246.6	32.884	-8.04
590	19277.7	33.799	-6.99	650	21292.5	33.353	-7.78	710	23279.5	32.876	-8.04
591	19311.5	33.792	-7.00	651	21325.9	33.345	-7.79	711	23312.3	32.868	-8.04
592	19345.3	33.785	-7.02	652	21359.2	33.337	-7.80	712	23345.2	32.860	-8.04
593	19379.1	33.778	-7.04	653	21392.5	33.330	-7.81	713	23378.1	32.852	-8.04
594	19412.9	33.771	-7.06	654	21425.9	33.322	-7.82	714	23410.9	32.844	-8.04
595	19446.6	33.764	-7.08	655	21459.2	33.314	-7.82	715	23443.7	32.836	-8.04
596	19480.4	33.757	-7.09	656	21492.5	33.306	-7.83	716	23476.6	32.828	-8.04
597	19514.1	33.750	-7.11	657	21525.8	33.298	-7.84	717	23509.4	32.820	-8.04
598	19547.9	33.743	-7.13	658	21559.1	33.290	-7.85	718	23542.2	32.812	-8.04
599	19581.6	33.735	-7.14	659	21592.4	33.283	-7.85	719	23575.0	32.804	-8.04
600	19615.4	33.728	-7.16	660	21625.7	33.275	-7.86	720	23607.8	32.796	-8.04

TABLE 7.4.2. *Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	23607.8	32.796	-8.04	780	25561.2	32.318	-7.85	840	27486.3	31.859	-7.44
721	23640.6	32.788	-8.04	781	25593.5	32.310	-7.84	841	27518.2	31.851	-7.43
722	23673.4	32.780	-8.04	782	25625.8	32.302	-7.83	842	27550.0	31.844	-7.42
723	23706.2	32.771	-8.04	783	25658.1	32.294	-7.83	843	27581.9	31.836	-7.41
724	23738.9	32.763	-8.04	784	25690.4	32.286	-7.82	844	27613.7	31.829	-7.40
725	23771.7	32.755	-8.03	785	25722.7	32.278	-7.82	845	27645.5	31.821	-7.40
726	23804.5	32.747	-8.03	786	25754.9	32.271	-7.81	846	27677.3	31.814	-7.39
727	23837.2	32.739	-8.03	787	25787.2	32.263	-7.81	847	27709.2	31.807	-7.38
728	23869.9	32.731	-8.03	788	25819.5	32.255	-7.80	848	27741.0	31.799	-7.37
729	23902.7	32.723	-8.03	789	25851.7	32.247	-7.79	849	27772.7	31.792	-7.37
730	23935.4	32.715	-8.03	790	25883.9	32.239	-7.79	850	27804.5	31.785	-7.36
731	23968.1	32.707	-8.03	791	25916.2	32.232	-7.78	851	27836.3	31.777	-7.35
732	24000.8	32.699	-8.02	792	25948.4	32.224	-7.78	852	27868.1	31.770	-7.34
733	24033.5	32.691	-8.02	793	25980.6	32.216	-7.77	853	27899.9	31.763	-7.33
734	24066.2	32.683	-8.02	794	26012.8	32.208	-7.76	854	27931.6	31.755	-7.33
735	24098.9	32.675	-8.02	795	26045.0	32.201	-7.76	855	27963.4	31.748	-7.32
736	24131.5	32.667	-8.02	796	26077.2	32.193	-7.75	856	27995.1	31.741	-7.31
737	24164.2	32.659	-8.02	797	26109.4	32.185	-7.74	857	28026.9	31.733	-7.30
738	24196.8	32.651	-8.01	798	26141.6	32.177	-7.74	858	28058.6	31.726	-7.29
739	24229.5	32.643	-8.01	799	26173.8	32.170	-7.73	859	28090.3	31.719	-7.29
740	24262.1	32.635	-8.01	800	26206.0	32.162	-7.72	860	28122.0	31.711	-7.28
741	24294.8	32.627	-8.01	801	26238.1	32.154	-7.72	861	28153.7	31.704	-7.27
742	24327.4	32.619	-8.00	802	26270.3	32.146	-7.71	862	28185.4	31.697	-7.26
743	24360.0	32.611	-8.00	803	26302.4	32.139	-7.70	863	28217.1	31.690	-7.26
744	24392.6	32.603	-8.00	804	26334.5	32.131	-7.70	864	28248.8	31.682	-7.25
745	24425.2	32.595	-7.99	805	26366.7	32.123	-7.69	865	28280.5	31.675	-7.24
746	24457.8	32.587	-7.99	806	26398.8	32.116	-7.68	866	28312.2	31.668	-7.23
747	24490.4	32.579	-7.99	807	26430.9	32.108	-7.68	867	28343.8	31.661	-7.22
748	24523.0	32.571	-7.99	808	26463.0	32.100	-7.67	868	28375.5	31.653	-7.22
749	24555.5	32.563	-7.98	809	26495.1	32.093	-7.66	869	28407.1	31.646	-7.21
750	24588.1	32.555	-7.98	810	26527.2	32.085	-7.66	870	28438.8	31.639	-7.20
751	24620.6	32.547	-7.98	811	26559.3	32.077	-7.65	871	28470.4	31.632	-7.19
752	24653.2	32.539	-7.97	812	26591.3	32.070	-7.64	872	28502.0	31.625	-7.19
753	24685.7	32.531	-7.97	813	26623.4	32.062	-7.64	873	28533.7	31.617	-7.18
754	24718.2	32.523	-7.97	814	26655.5	32.054	-7.63	874	28565.3	31.610	-7.17
755	24750.8	32.515	-7.96	815	26687.5	32.047	-7.62	875	28596.9	31.603	-7.16
756	24783.3	32.507	-7.96	816	26719.6	32.039	-7.61	876	28628.5	31.596	-7.15
757	24815.8	32.499	-7.95	817	26751.6	32.032	-7.61	877	28660.1	31.589	-7.15
758	24848.3	32.491	-7.95	818	26783.6	32.024	-7.60	878	28691.7	31.582	-7.14
759	24880.8	32.483	-7.95	819	26815.6	32.016	-7.59	879	28723.2	31.574	-7.13
760	24913.2	32.476	-7.94	820	26847.7	32.009	-7.59	880	28754.8	31.567	-7.12
761	24945.7	32.468	-7.94	821	26879.7	32.001	-7.58	881	28786.4	31.560	-7.12
762	24978.2	32.460	-7.93	822	26911.7	31.994	-7.57	882	28817.9	31.553	-7.11
763	25010.6	32.452	-7.93	823	26943.6	31.986	-7.56	883	28849.5	31.546	-7.10
764	25043.1	32.444	-7.92	824	26975.6	31.978	-7.56	884	28881.0	31.539	-7.09
765	25075.5	32.436	-7.92	825	27007.6	31.971	-7.55	885	28912.5	31.532	-7.09
766	25107.9	32.428	-7.92	826	27039.6	31.963	-7.54	886	28944.1	31.525	-7.08
767	25140.4	32.420	-7.91	827	27071.5	31.956	-7.53	887	28975.6	31.518	-7.07
768	25172.8	32.412	-7.91	828	27103.5	31.948	-7.53	888	29007.1	31.511	-7.06
769	25205.2	32.404	-7.90	829	27135.4	31.941	-7.52	889	29038.6	31.504	-7.06
770	25237.6	32.396	-7.90	830	27167.4	31.933	-7.51	890	29070.1	31.496	-7.05
771	25270.0	32.388	-7.89	831	27199.3	31.926	-7.50	891	29101.6	31.489	-7.04
772	25302.4	32.381	-7.89	832	27231.2	31.918	-7.50	892	29133.1	31.482	-7.03
773	25334.7	32.373	-7.88	833	27263.1	31.911	-7.49	893	29164.6	31.475	-7.03
774	25367.1	32.365	-7.88	834	27295.0	31.903	-7.48	894	29196.0	31.468	-7.02
775	25399.5	32.357	-7.87	835	27326.9	31.896	-7.47	895	29227.5	31.461	-7.01
776	25431.8	32.349	-7.87	836	27358.8	31.888	-7.47	896	29259.0	31.454	-7.01
777	25464.2	32.341	-7.86	837	27390.7	31.881	-7.46	897	29290.4	31.447	-7.00
778	25496.5	32.333	-7.86	838	27422.6	31.873	-7.45	898	29321.9	31.440	-6.99
779	25528.8	32.325	-7.85	839	27454.5	31.866	-7.44	899	29353.3	31.433	-6.98
780	25561.2	32.318	-7.85	840	27486.3	31.859	-7.44	900	29384.7	31.426	-6.98

TABLE 7.4.2. Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	29384.7	31.426	-6.98	960	31258.0	31.019	-6.65	1020	33107.2	30.622	-6.64
901	29416.2	31.419	-6.97	961	31289.0	31.012	-6.65	1021	33137.8	30.615	-6.65
902	29447.6	31.412	-6.96	962	31320.0	31.005	-6.64	1022	33168.4	30.609	-6.65
903	29479.0	31.405	-6.96	963	31351.0	30.999	-6.64	1023	33199.0	30.602	-6.65
904	29510.4	31.399	-6.95	964	31382.0	30.992	-6.64	1024	33229.6	30.596	-6.66
905	29541.8	31.392	-6.94	965	31413.0	30.986	-6.63	1025	33260.2	30.589	-6.66
906	29573.2	31.385	-6.93	966	31444.0	30.979	-6.63	1026	33290.8	30.582	-6.67
907	29604.5	31.378	-6.93	967	31475.0	30.972	-6.63	1027	33321.4	30.576	-6.67
908	29635.9	31.371	-6.92	968	31505.9	30.966	-6.62	1028	33352.0	30.569	-6.68
909	29667.3	31.364	-6.91	969	31536.9	30.959	-6.62	1029	33382.5	30.562	-6.68
910	29698.6	31.357	-6.91	970	31567.8	30.952	-6.62	1030	33413.1	30.555	-6.69
911	29730.0	31.350	-6.90	971	31598.8	30.946	-6.62	1031	33443.6	30.549	-6.69
912	29761.3	31.343	-6.89	972	31629.7	30.939	-6.62	1032	33474.2	30.542	-6.70
913	29792.7	31.336	-6.89	973	31660.7	30.933	-6.61	1033	33504.7	30.535	-6.70
914	29824.0	31.329	-6.88	974	31691.6	30.926	-6.61	1034	33535.3	30.529	-6.71
915	29855.3	31.322	-6.88	975	31722.5	30.919	-6.61	1035	33565.8	30.522	-6.71
916	29886.7	31.316	-6.87	976	31753.4	30.913	-6.61	1036	33596.3	30.515	-6.72
917	29918.0	31.309	-6.86	977	31784.3	30.906	-6.61	1037	33626.8	30.509	-6.73
918	29949.3	31.302	-6.86	978	31815.2	30.900	-6.60	1038	33657.3	30.502	-6.73
919	29980.6	31.295	-6.85	979	31846.1	30.893	-6.60	1039	33687.8	30.495	-6.74
920	30011.9	31.288	-6.84	980	31877.0	30.886	-6.60	1040	33718.3	30.488	-6.75
921	30043.2	31.281	-6.84	981	31907.9	30.880	-6.60	1041	33748.8	30.482	-6.75
922	30074.4	31.275	-6.83	982	31938.8	30.873	-6.60	1042	33779.3	30.475	-6.76
923	30105.7	31.268	-6.83	983	31969.7	30.866	-6.60	1043	33809.7	30.468	-6.77
924	30137.0	31.261	-6.82	984	32000.5	30.860	-6.60	1044	33840.2	30.461	-6.77
925	30168.2	31.254	-6.81	985	32031.4	30.853	-6.60	1045	33870.7	30.455	-6.78
926	30199.5	31.247	-6.81	986	32062.2	30.847	-6.59	1046	33901.1	30.448	-6.79
927	30230.7	31.240	-6.80	987	32093.1	30.840	-6.59	1047	33931.6	30.441	-6.80
928	30262.0	31.234	-6.80	988	32123.9	30.834	-6.59	1048	33962.0	30.434	-6.81
929	30293.2	31.227	-6.79	989	32154.7	30.827	-6.59	1049	33992.4	30.427	-6.81
930	30324.4	31.220	-6.78	990	32185.6	30.820	-6.59	1050	34022.9	30.421	-6.82
931	30355.6	31.213	-6.78	991	32216.4	30.814	-6.59	1051	34053.3	30.414	-6.83
932	30386.8	31.206	-6.77	992	32247.2	30.807	-6.59	1052	34083.7	30.407	-6.84
933	30418.0	31.200	-6.77	993	32278.0	30.801	-6.59	1053	34114.1	30.400	-6.85
934	30449.2	31.193	-6.76	994	32308.8	30.794	-6.59	1054	34144.5	30.393	-6.86
935	30480.4	31.186	-6.76	995	32339.6	30.787	-6.59	1055	34174.9	30.386	-6.87
936	30511.6	31.179	-6.75	996	32370.4	30.781	-6.59	1056	34205.3	30.379	-6.88
937	30542.8	31.173	-6.75	997	32401.1	30.774	-6.59	1057	34235.6	30.373	-6.89
938	30574.0	31.166	-6.74	998	32431.9	30.768	-6.59	1058	34266.0	30.366	-6.90
939	30605.1	31.159	-6.74	999	32462.7	30.761	-6.60	1059	34296.4	30.359	-6.90
940	30636.3	31.152	-6.73	1000	32493.4	30.754	-6.60	1060	34326.7	30.352	-6.92
941	30667.4	31.146	-6.73	1001	32524.2	30.748	-6.60	1061	34357.1	30.345	-6.93
942	30698.6	31.139	-6.72	1002	32554.9	30.741	-6.60	1062	34387.4	30.338	-6.94
943	30729.7	31.132	-6.72	1003	32585.7	30.735	-6.60	1063	34417.7	30.331	-6.95
944	30760.8	31.126	-6.71	1004	32616.4	30.728	-6.60	1064	34448.1	30.324	-6.96
945	30792.0	31.119	-6.71	1005	32647.1	30.721	-6.60	1065	34478.4	30.317	-6.97
946	30823.1	31.112	-6.70	1006	32677.8	30.715	-6.60	1066	34508.7	30.310	-6.98
947	30854.2	31.105	-6.70	1007	32708.6	30.708	-6.61	1067	34539.0	30.303	-6.99
948	30885.3	31.099	-6.69	1008	32739.3	30.702	-6.61	1068	34569.3	30.296	-7.00
949	30916.4	31.092	-6.69	1009	32770.0	30.695	-6.61	1069	34599.6	30.289	-7.01
950	30947.5	31.085	-6.69	1010	32800.7	30.688	-6.61	1070	34629.9	30.282	-7.03
951	30978.5	31.079	-6.68	1011	32831.3	30.682	-6.61	1071	34660.2	30.275	-7.04
952	31009.6	31.072	-6.68	1012	32862.0	30.675	-6.62	1072	34690.4	30.268	-7.05
953	31040.7	31.065	-6.67	1013	32892.7	30.669	-6.62	1073	34720.7	30.261	-7.06
954	31071.8	31.059	-6.67	1014	32923.4	30.662	-6.62	1074	34751.0	30.254	-7.08
955	31102.8	31.052	-6.67	1015	32954.0	30.655	-6.63	1075	34781.2	30.247	-7.09
956	31133.9	31.045	-6.66	1016	32984.7	30.649	-6.63	1076	34811.5	30.240	-7.10
957	31164.9	31.039	-6.66	1017	33015.3	30.642	-6.63	1077	34841.7	30.233	-7.12
958	31195.9	31.032	-6.66	1018	33045.9	30.635	-6.63	1078	34871.9	30.226	-7.13
959	31227.0	31.025	-6.65	1019	33076.6	30.629	-6.64	1079	34902.1	30.218	-7.14
960	31258.0	31.019	-6.65	1020	33107.2	30.622	-6.64	1080	34932.4	30.211	-7.16

TABLE 7.4.2. *Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1080	34932.4	30.211	-7.16	1140	36731.5	29.748	-8.41	1200	38500.1	29.183	-10.62
1081	34962.6	30.204	-7.17	1141	36761.3	29.740	-8.44	1201	38529.3	29.172	-10.67
1082	34992.8	30.197	-7.19	1142	36791.0	29.732	-8.47	1202	38558.5	29.161	-10.72
1083	35023.0	30.190	-7.20	1143	36820.7	29.723	-8.50	1203	38587.6	29.151	-10.76
1084	35053.1	30.182	-7.22	1144	36850.5	29.715	-8.53	1204	38616.8	29.140	-10.81
1085	35083.3	30.175	-7.23	1145	36880.2	29.706	-8.55	1205	38645.9	29.129	-10.86
1086	35113.5	30.168	-7.25	1146	36909.9	29.697	-8.58	1206	38675.0	29.118	-10.91
1087	35143.7	30.161	-7.26	1147	36939.6	29.689	-8.61	1207	38704.1	29.107	-10.95
1088	35173.8	30.154	-7.28	1148	36969.2	29.680	-8.64	1208	38733.2	29.096	-11.00
1089	35204.0	30.146	-7.29	1149	36998.9	29.672	-8.68	1209	38762.3	29.085	-11.05
1090	35234.1	30.139	-7.31	1150	37028.6	29.663	-8.71	1210	38791.4	29.074	-11.10
1091	35264.2	30.132	-7.33	1151	37058.2	29.654	-8.74	1211	38820.5	29.063	-11.15
1092	35294.4	30.124	-7.34	1152	37087.9	29.645	-8.77	1212	38849.5	29.052	-11.20
1093	35324.5	30.117	-7.36	1153	37117.5	29.637	-8.80	1213	38878.6	29.041	-11.25
1094	35354.6	30.110	-7.38	1154	37147.2	29.628	-8.83	1214	38907.6	29.029	-11.30
1095	35384.7	30.102	-7.39	1155	37176.8	29.619	-8.86	1215	38936.6	29.018	-11.35
1096	35414.8	30.095	-7.41	1156	37206.4	29.610	-8.90	1216	38965.7	29.007	-11.40
1097	35444.9	30.087	-7.43	1157	37236.0	29.601	-8.93	1217	38994.7	28.995	-11.46
1098	35475.0	30.080	-7.45	1158	37265.6	29.592	-8.96	1218	39023.6	28.984	-11.51
1099	35505.1	30.072	-7.46	1159	37295.2	29.583	-9.00	1219	39052.6	28.972	-11.56
1100	35535.1	30.065	-7.48	1160	37324.8	29.574	-9.03	1220	39081.6	28.961	-11.61
1101	35565.2	30.057	-7.50	1161	37354.3	29.565	-9.06	1221	39110.5	28.949	-11.67
1102	35595.2	30.050	-7.52	1162	37383.9	29.556	-9.10	1222	39139.5	28.937	-11.72
1103	35625.3	30.042	-7.54	1163	37413.5	29.547	-9.13	1223	39168.4	28.926	-11.77
1104	35655.3	30.035	-7.56	1164	37443.0	29.538	-9.17	1224	39197.3	28.914	-11.83
1105	35685.4	30.027	-7.58	1165	37472.5	29.529	-9.20	1225	39226.2	28.902	-11.88
1106	35715.4	30.020	-7.60	1166	37502.1	29.519	-9.24	1226	39255.1	28.890	-11.94
1107	35745.4	30.012	-7.62	1167	37531.6	29.510	-9.27	1227	39284.0	28.878	-11.99
1108	35775.4	30.004	-7.64	1168	37561.1	29.501	-9.31	1228	39312.9	28.866	-12.05
1109	35805.4	29.997	-7.66	1169	37590.6	29.492	-9.35	1229	39341.8	28.854	-12.11
1110	35835.4	29.989	-7.68	1170	37620.1	29.482	-9.38	1230	39370.6	28.842	-12.16
1111	35865.4	29.981	-7.70	1171	37649.5	29.473	-9.42	1231	39399.4	28.830	-12.22
1112	35895.4	29.974	-7.72	1172	37679.0	29.463	-9.46	1232	39428.3	28.817	-12.28
1113	35925.3	29.966	-7.74	1173	37708.5	29.454	-9.49	1233	39457.1	28.805	-12.33
1114	35955.3	29.958	-7.76	1174	37737.9	29.444	-9.53	1234	39485.9	28.793	-12.39
1115	35985.3	29.951	-7.79	1175	37767.3	29.435	-9.57	1235	39514.7	28.780	-12.45
1116	36015.2	29.943	-7.81	1176	37796.8	29.425	-9.61	1236	39543.4	28.768	-12.51
1117	36045.1	29.935	-7.83	1177	37826.2	29.416	-9.65	1237	39572.2	28.755	-12.57
1118	36075.1	29.927	-7.85	1178	37855.6	29.406	-9.69	1238	39600.9	28.743	-12.63
1119	36105.0	29.919	-7.87	1179	37885.0	29.396	-9.72	1239	39629.7	28.730	-12.69
1120	36134.9	29.911	-7.90	1180	37914.4	29.386	-9.76	1240	39658.4	28.717	-12.75
1121	36164.8	29.903	-7.92	1181	37943.8	29.377	-9.80	1241	39687.1	28.704	-12.81
1122	36194.7	29.895	-7.94	1182	37973.2	29.367	-9.84	1242	39715.8	28.692	-12.87
1123	36224.6	29.888	-7.97	1183	38002.5	29.357	-9.89	1243	39744.5	28.679	-12.93
1124	36254.5	29.880	-7.99	1184	38031.9	29.347	-9.93	1244	39773.2	28.666	-12.99
1125	36284.4	29.872	-8.02	1185	38061.2	29.337	-9.97	1245	39801.8	28.653	-13.05
1126	36314.2	29.864	-8.04	1186	38090.5	29.327	-10.01	1246	39830.5	28.640	-13.12
1127	36344.1	29.855	-8.07	1187	38119.9	29.317	-10.05	1247	39859.1	28.627	-13.18
1128	36373.9	29.847	-8.09	1188	38149.2	29.307	-10.09	1248	39887.7	28.613	-13.24
1129	36403.8	29.839	-8.12	1189	38178.5	29.297	-10.13	1249	39916.3	28.600	-13.31
1130	36433.6	29.831	-8.14	1190	38207.8	29.287	-10.18	1250	39944.9	28.587	-13.37
1131	36463.5	29.823	-8.17	1191	38237.1	29.277	-10.22	1251	39973.5	28.573	-13.43
1132	36493.3	29.815	-8.19	1192	38266.3	29.266	-10.26	1252	40002.1	28.560	-13.50
1133	36523.1	29.807	-8.22	1193	38295.6	29.256	-10.31	1253	40030.6	28.546	-13.56
1134	36552.9	29.798	-8.25	1194	38324.8	29.246	-10.35	1254	40059.2	28.533	-13.63
1135	36582.7	29.790	-8.27	1195	38354.1	29.235	-10.40	1255	40087.7	28.519	-13.70
1136	36612.5	29.782	-8.30	1196	38383.3	29.225	-10.44	1256	40116.2	28.505	-13.76
1137	36642.2	29.774	-8.33	1197	38412.5	29.214	-10.49	1257	40144.7	28.492	-13.83
1138	36672.0	29.765	-8.35	1198	38441.7	29.204	-10.53	1258	40173.2	28.478	-13.90
1139	36701.8	29.757	-8.38	1199	38470.9	29.193	-10.58	1259	40201.7	28.464	-13.96
1140	36731.5	29.748	-8.41	1200	38500.1	29.183	-10.62	1260	40230.1	28.450	-14.03

TABLE 7.4.2. *Type KP (or EP) thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0°C —Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1260	40230.1	28.450	-14.03	1300	41356.1	27.830	-17.09	1340	42454.7	27.073	-20.86
1261	40258.6	28.436	-14.10	1301	41383.9	27.812	-17.17	1341	42481.7	27.052	-20.97
1262	40287.0	28.422	-14.17	1302	41411.7	27.795	-17.26	1342	42508.8	27.031	-21.07
1263	40315.4	28.407	-14.24	1303	41439.5	27.778	-17.35	1343	42535.8	27.010	-21.18
1264	40343.8	28.393	-14.31	1304	41467.3	27.761	-17.43	1344	42562.8	26.989	-21.28
1265	40372.2	28.379	-14.38	1305	41495.0	27.743	-17.52	1345	42589.8	26.967	-21.39
1266	40400.6	28.364	-14.45	1306	41522.8	27.726	-17.61	1346	42616.7	26.946	-21.50
1267	40428.9	28.350	-14.52	1307	41550.5	27.708	-17.70	1347	42643.7	26.924	-21.60
1268	40457.3	28.335	-14.59	1308	41578.2	27.690	-17.78	1348	42670.6	26.903	-21.71
1269	40485.6	28.321	-14.66	1309	41605.9	27.672	-17.87	1349	42697.5	26.881	-21.82
1270	40513.9	28.306	-14.73	1310	41633.5	27.654	-17.96	1350	42724.3	26.859	-21.93
1271	40542.2	28.291	-14.81	1311	41661.2	27.636	-18.05	1351	42751.2	26.837	-22.04
1272	40570.5	28.276	-14.88	1312	41688.8	27.618	-18.14	1352	42778.0	26.815	-22.15
1273	40598.8	28.261	-14.95	1313	41716.4	27.600	-18.23	1353	42804.8	26.793	-22.26
1274	40627.0	28.246	-15.02	1314	41744.0	27.582	-18.33	1354	42831.6	26.771	-22.37
1275	40655.2	28.231	-15.10	1315	41771.6	27.563	-18.42	1355	42858.4	26.748	-22.48
1276	40683.5	28.216	-15.17	1316	41799.1	27.545	-18.51	1356	42885.1	26.726	-22.59
1277	40711.7	28.201	-15.25	1317	41826.7	27.526	-18.60	1357	42911.8	26.703	-22.70
1278	40739.9	28.186	-15.32	1318	41854.2	27.508	-18.69	1358	42938.5	26.680	-22.82
1279	40768.1	28.170	-15.40	1319	41881.7	27.489	-18.79	1359	42965.2	26.657	-22.93
1280	40796.2	28.155	-15.48	1320	41909.2	27.470	-18.88	1360	42991.8	26.634	-23.04
1281	40824.4	28.139	-15.55	1321	41936.6	27.451	-18.98	1361	43018.4	26.611	-23.16
1282	40852.5	28.124	-15.63	1322	41964.1	27.432	-19.07	1362	43045.0	26.588	-23.27
1283	40880.6	28.108	-15.71	1323	41991.5	27.413	-19.17	1363	43071.6	26.565	-23.39
1284	40908.7	28.092	-15.78	1324	42018.9	27.394	-19.26	1364	43098.2	26.541	-23.51
1285	40936.8	28.077	-15.86	1325	42046.3	27.375	-19.36	1365	43124.7	26.518	-23.62
1286	40964.9	28.061	-15.94	1326	42073.6	27.355	-19.46	1366	43151.2	26.494	-23.74
1287	40992.9	28.045	-16.02	1327	42101.0	27.336	-19.55	1367	43177.7	26.470	-23.86
1288	41021.0	28.029	-16.10	1328	42128.3	27.316	-19.65	1368	43204.1	26.446	-23.98
1289	41049.0	28.013	-16.18	1329	42155.6	27.296	-19.75	1369	43230.6	26.422	-24.09
1290	41077.0	27.996	-16.26	1330	42182.9	27.277	-19.85	1370	43257.0	26.398	-24.21
1291	41105.0	27.980	-16.34	1331	42210.2	27.257	-19.95	1371	43283.4	26.374	-24.33
1292	41132.9	27.964	-16.42	1332	42237.4	27.237	-20.05	1372	43309.7	26.349	-24.45
1293	41160.9	27.947	-16.50	1333	42264.7	27.217	-20.15				
1294	41188.8	27.931	-16.59	1334	42291.9	27.196	-20.25				
1295	41216.8	27.914	-16.67	1335	42319.0	27.176	-20.35				
1296	41244.7	27.897	-16.75	1336	42346.2	27.156	-20.45				
1297	41272.5	27.880	-16.84	1337	42373.4	27.135	-20.55				
1298	41300.4	27.864	-16.92	1338	42400.5	27.115	-20.66				
1299	41328.3	27.847	-17.00	1339	42427.6	27.094	-20.76				
1300	41356.1	27.830	-17.09	1340	42454.7	27.073	-20.86				

TABLE 7.4.3. *Thermoelectric values at the fixed points for Type KP (or EP) thermoelements versus platinum, Pt-67*

Fixed point	Temp. °C	E μV	S μV/°C	dS/dT nV/°C ²
Helium NBP	-268.935	-3556.88	0.847	0.03
Hydrogen TP	-259.340	-3548.49	0.917	10.59
Hydrogen NBP	-252.870	-3542.32	0.994	13.83
Neon TP	-248.595	-3537.93	1.062	18.56
Neon NBP	-246.048	-3535.16	1.114	22.65
Oxygen TP	-218.789	-3487.84	2.722	99.92
Nitrogen TP	-210.002	-3459.76	3.701	121.77
Nitrogen NBP	-195.802	-3394.09	5.597	142.26
Oxygen NBP	-182.962	-3310.29	7.465	146.76
Carbon Dioxide SP	-78.476	-1817.20	20.060	90.50
Mercury FP	-38.862	-956.08	23.295	71.96
Ice point*	0.000	0.00	25.836	52.24
Ether TP	26.870	712.4	27.168	46.97
Water BP	100.000	2812.8	30.117	34.00
Benzoic TP	122.370	3494.7	30.837	30.44
Indium FP	156.634	4568.2	31.791	25.32
Tin FP	231.9681	7025.3	33.319	15.56
Bismuth FP	271.442	8351.5	33.845	11.22
Cadmium FP	321.108	10044.3	34.282	6.49
Lead FP	327.502	10263.6	34.322	5.94
Mercury BP	356.660	11266.5	34.460	3.58
Zinc FP	419.580	13438.8	34.546	-0.65
Sulphur BP	444.674	14305.4	34.512	-2.03
Cu-Al FP	548.23	17860.1	34.072	-6.04
Antimony FP	630.74	20648.7	33.501	-7.59
Aluminum FP	660.37	21638.0	33.272	-7.86
Silver FP	961.93	31317.8	31.006	-6.64
Gold FP	1064.43	34461.1	30.321	-6.96
Copper FP	1084.5	35068.2	30.179	-7.22

*Junction point of different functions.

TABLE 7.4.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage for Type KP (or EP) thermoelements versus platinum, Pt-67*

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-270 to -200 °C	12	(*)	500	2	0.1	<0.01
-200 to 0 °C	12	400	50	0.2	<0.01	<0.01
0 to 200 °C	6	2	0.07	<0.01	<0.01	<0.01
200 to 400 °C	6	3	0.08	<0.01	<0.01	<0.01
400 to 600 °C	6	4	0.08	<0.01	<0.01	<0.01
600 to 800 °C	6	6	0.2	<0.01	<0.01	<0.01
800 to 1000 °C	6	9	0.5	<0.01	<0.01	<0.01
1000 to 1200 °C	6	11	0.9	0.01	<0.01	<0.01
1200 to 1372 °C	6	13	1	0.02	<0.01	<0.01

*A high-order polynomial with a low-bit machine causes extreme error.

7.5. Reference Functions and Tables for Platinum, Pt-67, Versus the Negative Thermoelement, Type KN, a Nickel-Aluminum Alloy

The coefficients for the twelfth degree expansion for the thermoelectric voltage of Pt-67 versus Type KN thermoelements below 0 °C are given in table 7.5.1. The coefficients for the eighth degree expansion plus an exponential term for use above 0 °C are also given in table 7.5.1. The errors caused by using reduced bit arithmetic for calculating values of the functions are given in table 7.5.4.

The primary reference values for Pt-67 versus Type KN thermoelements are given in table 7.5.2. Values at selected fixed points are given in table 7.5.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 7.5.1, 7.5.2, and 7.5.3, respectively.

It should be stressed that **Type KN thermoelement material that conforms closely to the high temperature tabular values may not necessarily conform closely at low temperatures (below 0 °C) and vice versa.** If type KN thermoelements are to be used for accurate measurements both above and below 0 °C, then the material must be calibrated in the full temperature range, both above and below 0 °C. Special selection of material will often be required.

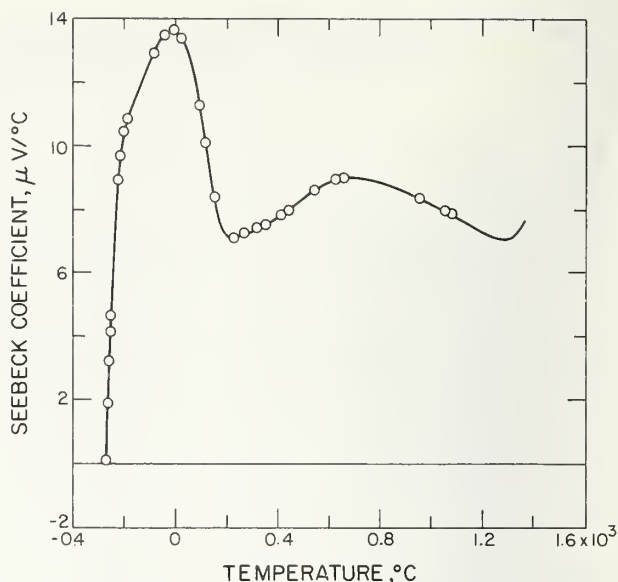


FIGURE 7.5.2. Seebeck coefficient for platinum, Pt-67, versus Type KN thermoelements.

The circles indicate values at various thermometric fixed points on the IPTS-68.

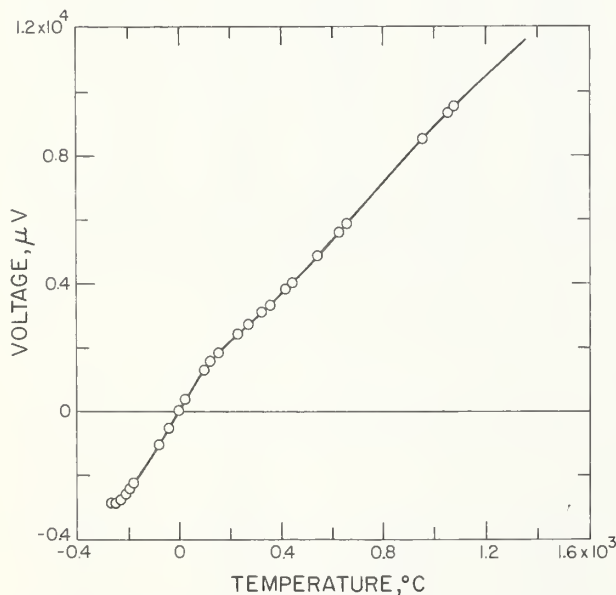


FIGURE 7.5.1. Thermoelectric voltage for platinum, Pt-67, versus Type KN thermoelements.

The circles indicate values at various thermometric fixed points on the IPTS-68.

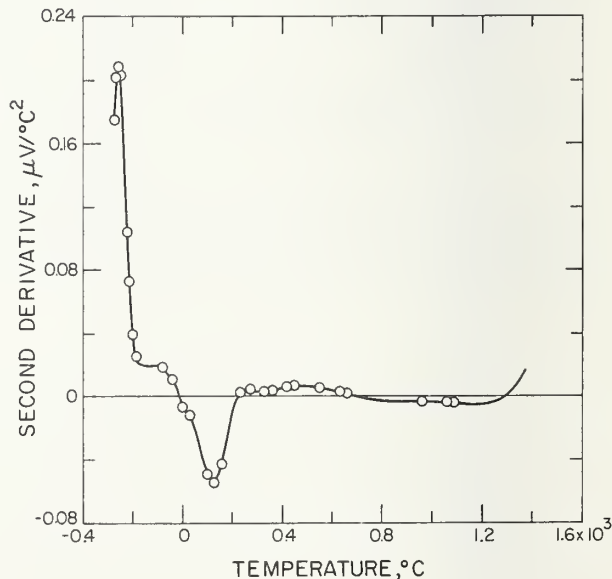


FIGURE 7.5.3. Second derivative of thermoelectric voltage for platinum, Pt-67, versus Type KN thermoelements.

The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 7.5.1. *Power series expansion for the thermoelectric voltage of platinum, Pt-67, versus KN thermoelements*

Temperature range	Degree	Coefficients	Term
-270 to 0 °C	12	1.3639723006×10^1	T
		$2.6310472300 \times 10^{-4}$	T^2
		$2.1780230928 \times 10^{-4}$	T^3
		$1.5321974393 \times 10^{-5}$	T^4
		$4.2195997423 \times 10^{-7}$	T^5
		$6.7685672229 \times 10^{-9}$	T^6
		$6.8555647886 \times 10^{-11}$	T^7
		$4.5113962880 \times 10^{-13}$	T^8
		$1.9240013493 \times 10^{-15}$	T^9
		$5.1234269588 \times 10^{-18}$	T^{10}
		$7.7268515186 \times 10^{-21}$	T^{11}
		$5.0290738536 \times 10^{-24}$	T^{12}
0 to 1372 °C	8 + exp.	$-1.8533063273 \times 10^1$	...
		1.3082634479×10^1	T
		$-9.4769979320 \times 10^{-3}$	T^2
		$-4.5149050693 \times 10^{-5}$	T^3
		$2.1245645455 \times 10^{-7}$	T^4
		$-3.5639856324 \times 10^{-10}$	T^5
		$3.0053784151 \times 10^{-13}$	T^6
		$-1.2849848798 \times 10^{-16}$	T^7
		$2.2239974336 \times 10^{-20}$	T^8
		$+ 125 \exp \left[-\frac{1}{2} \left(\frac{T-127}{65} \right)^2 \right]$	

TABLE 7.5.2. *Platinum, Pt-67, versus Type KN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-270	-2900.03	-0.110	172.01	-240	-2815.99	5.807	186.94	-210	-2574.87	9.672	72.09
-269	-2900.06	0.063	174.72	-239	-2810.09	5.992	183.72	-209	-2565.16	9.743	69.05
-268	-2899.91	0.239	177.61	-238	-2804.00	6.174	180.33	-208	-2555.38	9.810	66.11
-267	-2899.58	0.418	180.61	-237	-2797.74	6.353	176.81	-207	-2545.54	9.875	63.29
-266	-2899.07	0.601	183.65	-236	-2791.30	6.528	173.15	-206	-2535.64	9.937	60.56
-265	-2898.37	0.786	186.68	-235	-2784.69	6.699	169.37	-205	-2525.67	9.996	57.95
-264	-2897.50	0.974	189.63	-234	-2777.90	6.867	165.50	-204	-2515.64	10.053	55.45
-263	-2896.43	1.165	192.47	-233	-2770.95	7.030	161.54	-203	-2505.56	10.107	53.05
-262	-2895.16	1.359	195.16	-232	-2763.84	7.190	157.50	-202	-2495.43	10.159	50.76
-261	-2893.71	1.555	197.65	-231	-2756.58	7.345	153.41	-201	-2485.25	10.208	48.58
-260	-2892.05	1.754	199.93	-230	-2749.16	7.496	149.27	-200	-2475.02	10.256	46.50
-259	-2890.20	1.955	201.97	-229	-2741.59	7.644	145.09	-199	-2464.74	10.301	44.52
-258	-2888.14	2.158	203.74	-228	-2733.87	7.787	140.89	-198	-2454.41	10.345	42.65
-257	-2885.88	2.362	205.24	-227	-2726.01	7.925	136.68	-197	-2444.05	10.387	40.88
-256	-2883.42	2.568	206.45	-226	-2718.02	8.060	132.47	-196	-2433.64	10.427	39.20
-255	-2880.75	2.775	207.37	-225	-2709.90	8.190	128.28	-195	-2423.19	10.465	37.62
-254	-2877.87	2.983	207.98	-224	-2701.64	8.317	124.10	-194	-2412.71	10.502	36.13
-253	-2874.78	3.191	208.29	-223	-2693.26	8.439	119.95	-193	-2402.19	10.538	34.73
-252	-2871.49	3.399	208.29	-222	-2684.77	8.556	115.85	-192	-2391.64	10.572	33.42
-251	-2867.98	3.607	207.99	-221	-2676.15	8.670	111.79	-191	-2381.05	10.604	32.19
-250	-2864.27	3.815	207.39	-220	-2667.43	8.780	107.78	-190	-2370.43	10.636	31.04
-249	-2860.35	4.022	206.50	-219	-2658.59	8.886	103.84	-189	-2359.78	10.667	29.97
-248	-2856.23	4.228	205.32	-218	-2649.66	8.988	99.97	-188	-2349.09	10.696	28.98
-247	-2851.90	4.433	203.87	-217	-2640.62	9.086	96.17	-187	-2338.38	10.724	28.06
-246	-2847.36	4.636	202.15	-216	-2631.49	9.180	92.45	-186	-2327.65	10.752	27.20
-245	-2842.63	4.837	200.18	-215	-2622.26	9.271	88.82	-185	-2316.88	10.779	26.42
-244	-2837.69	5.036	197.96	-214	-2612.95	9.358	85.28	-184	-2306.09	10.805	25.69
-243	-2832.55	5.233	195.52	-213	-2603.55	9.441	81.84	-183	-2295.27	10.830	25.02
-242	-2827.22	5.427	192.86	-212	-2594.06	9.521	78.49	-182	-2284.43	10.855	24.41
-241	-2821.70	5.618	189.99	-211	-2584.50	9.598	75.24	-181	-2273.56	10.879	23.86
-240	-2815.99	5.807	186.94	-210	-2574.87	9.672	72.09	-180	-2262.67	10.903	23.35

TABLE 7.5.2. *Platinum, Pt-67, versus Type KN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-180	-2262.67	10.903	23.35	-120	-1572.01	12.099	19.70	-60	-810.93	13.214	14.01
-179	-2251.76	10.926	22.89	-119	-1559.90	12.119	19.73	-59	-797.71	13.228	13.80
-178	-2240.82	10.949	22.47	-118	-1547.77	12.139	19.76	-58	-784.47	13.241	13.60
-177	-2229.86	10.971	22.10	-117	-1535.63	12.159	19.79	-57	-771.23	13.255	13.40
-176	-2218.88	10.993	21.76	-116	-1523.46	12.178	19.82	-56	-757.96	13.268	13.21
-175	-2207.87	11.014	21.46	-115	-1511.27	12.198	19.86	-55	-744.69	13.281	13.02
-174	-2196.85	11.036	21.19	-114	-1499.06	12.218	19.89	-54	-731.40	13.294	12.84
-173	-2185.80	11.057	20.95	-113	-1486.83	12.238	19.92	-53	-718.10	13.307	12.67
-172	-2174.73	11.078	20.74	-112	-1474.58	12.258	19.95	-52	-704.79	13.319	12.51
-171	-2163.65	11.098	20.55	-111	-1462.32	12.278	19.98	-51	-691.46	13.332	12.35
-170	-2152.54	11.119	20.39	-110	-1450.03	12.298	20.01	-50	-678.13	13.344	12.20
-169	-2141.41	11.139	20.25	-109	-1437.72	12.318	20.04	-49	-664.78	13.356	12.05
-168	-2130.26	11.159	20.12	-108	-1425.39	12.338	20.06	-48	-651.41	13.368	11.91
-167	-2119.09	11.179	20.02	-107	-1413.04	12.358	20.09	-47	-638.04	13.380	11.78
-166	-2107.90	11.199	19.93	-106	-1400.68	12.378	20.11	-46	-624.65	13.392	11.64
-165	-2096.69	11.219	19.85	-105	-1388.29	12.398	20.12	-45	-611.26	13.403	11.52
-164	-2085.46	11.239	19.79	-104	-1375.88	12.418	20.14	-44	-597.85	13.415	11.39
-163	-2074.21	11.259	19.74	-103	-1363.45	12.439	20.14	-43	-584.43	13.426	11.27
-162	-2062.95	11.278	19.69	-102	-1351.00	12.459	20.15	-42	-570.99	13.437	11.15
-161	-2051.66	11.298	19.66	-101	-1338.53	12.479	20.14	-41	-557.55	13.448	11.02
-160	-2040.35	11.318	19.63	-100	-1326.05	12.499	20.14	-40	-544.10	13.459	10.90
-159	-2029.02	11.337	19.60	-99	-1313.54	12.519	20.12	-39	-530.63	13.470	10.77
-158	-2017.67	11.357	19.59	-98	-1301.01	12.539	20.10	-38	-517.16	13.481	10.63
-157	-2006.31	11.377	19.57	-97	-1288.46	12.559	20.07	-37	-503.67	13.492	10.49
-156	-1994.92	11.396	19.56	-96	-1275.89	12.579	20.04	-36	-490.17	13.502	10.34
-155	-1983.52	11.416	19.55	-95	-1263.30	12.599	19.99	-35	-476.67	13.512	10.18
-154	-1972.09	11.435	19.55	-94	-1250.69	12.619	19.94	-34	-463.15	13.522	10.00
-153	-1960.65	11.455	19.54	-93	-1238.06	12.639	19.88	-33	-449.62	13.532	9.81
-152	-1949.18	11.474	19.54	-92	-1225.41	12.659	19.82	-32	-436.09	13.542	9.60
-151	-1937.70	11.494	19.53	-91	-1212.74	12.679	19.74	-31	-422.54	13.551	9.37
-150	-1926.19	11.513	19.53	-90	-1200.05	12.699	19.66	-30	-408.98	13.561	9.12
-149	-1914.67	11.533	19.53	-89	-1187.35	12.718	19.56	-29	-395.42	13.570	8.85
-148	-1903.13	11.552	19.52	-88	-1174.62	12.738	19.46	-28	-381.84	13.578	8.55
-147	-1891.57	11.572	19.52	-87	-1161.87	12.757	19.35	-27	-368.26	13.587	8.23
-146	-1879.98	11.591	19.52	-86	-1149.10	12.776	19.23	-26	-354.67	13.595	7.88
-145	-1868.38	11.611	19.51	-85	-1136.32	12.796	19.10	-25	-341.07	13.602	7.50
-144	-1856.76	11.630	19.51	-84	-1123.51	12.815	18.96	-24	-327.47	13.610	7.09
-143	-1845.12	11.650	19.51	-83	-1110.69	12.833	18.81	-23	-313.85	13.617	6.65
-142	-1833.46	11.669	19.50	-82	-1097.85	12.852	18.65	-22	-300.23	13.623	6.18
-141	-1821.78	11.689	19.50	-81	-1084.98	12.871	18.49	-21	-286.61	13.629	5.68
-140	-1810.08	11.708	19.50	-80	-1072.10	12.889	18.32	-20	-272.97	13.634	5.15
-139	-1798.37	11.728	19.49	-79	-1059.21	12.907	18.14	-19	-259.34	13.639	4.59
-138	-1786.63	11.747	19.49	-78	-1046.29	12.925	17.95	-18	-245.70	13.644	4.01
-137	-1774.87	11.767	19.49	-77	-1033.35	12.943	17.76	-17	-232.05	13.647	3.41
-136	-1763.09	11.786	19.49	-76	-1020.40	12.961	17.55	-16	-218.40	13.650	2.80
-135	-1751.30	11.806	19.49	-75	-1007.43	12.978	17.35	-15	-204.75	13.653	2.17
-134	-1739.48	11.825	19.49	-74	-994.45	12.996	17.14	-14	-191.10	13.655	1.54
-133	-1727.65	11.845	19.49	-73	-981.44	13.013	16.92	-13	-177.44	13.656	0.91
-132	-1715.79	11.864	19.50	-72	-968.42	13.029	16.70	-12	-163.78	13.657	0.30
-131	-1703.92	11.884	19.50	-71	-955.38	13.046	16.48	-11	-150.13	13.657	-0.28
-130	-1692.02	11.903	19.51	-70	-942.33	13.062	16.25	-10	-136.47	13.656	-0.83
-129	-1680.11	11.923	19.52	-69	-929.26	13.079	16.03	-9	-122.82	13.655	-1.32
-128	-1668.18	11.942	19.53	-68	-916.17	13.094	15.80	-8	-109.16	13.653	-1.74
-127	-1656.23	11.962	19.55	-67	-903.07	13.110	15.57	-7	-95.51	13.651	-2.06
-126	-1644.25	11.982	19.56	-66	-889.95	13.126	15.34	-6	-81.86	13.649	-2.28
-125	-1632.26	12.001	19.58	-65	-876.82	13.141	15.11	-5	-68.21	13.647	-2.35
-124	-1620.25	12.021	19.60	-64	-863.67	13.156	14.88	-4	-54.57	13.645	-2.25
-123	-1608.22	12.040	19.62	-63	-850.51	13.171	14.66	-3	-40.92	13.643	-1.95
-122	-1596.17	12.060	19.65	-62	-837.33	13.185	14.44	-2	-27.28	13.641	-1.42
-121	-1584.10	12.080	19.67	-61	-824.14	13.200	14.22	-1	-13.64	13.640	-0.60
-120	-1572.01	12.099	19.70	-60	-810.93	13.214	14.01	0	0.00	13.640	0.53

TABLE 7.5.2. *Platinum, Pt-67, versus Type KN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.0	13.640	-6.59	60	798.5	12.785	-26.37	120	1497.2	10.205	-54.40
1	13.6	13.633	-6.76	61	811.3	12.758	-26.94	121	1507.4	10.150	-54.45
2	27.3	13.626	-6.92	62	824.0	12.731	-27.52	122	1517.5	10.096	-54.47
3	40.9	13.619	-7.09	63	836.8	12.703	-28.10	123	1527.6	10.041	-54.47
4	54.5	13.612	-7.25	64	849.5	12.675	-28.69	124	1537.6	9.987	-54.45
5	68.1	13.605	-7.42	65	862.1	12.646	-29.29	125	1547.6	9.933	-54.40
6	81.7	13.597	-7.59	66	874.7	12.616	-29.88	126	1557.5	9.878	-54.34
7	95.3	13.590	-7.77	67	887.3	12.586	-30.49	127	1567.3	9.824	-54.25
8	108.9	13.582	-7.94	68	899.9	12.555	-31.09	128	1577.1	9.770	-54.14
9	122.5	13.574	-8.12	69	912.5	12.524	-31.70	129	1586.9	9.716	-54.01
10	136.0	13.565	-8.30	70	925.0	12.492	-32.31	130	1596.5	9.662	-53.85
11	149.6	13.557	-8.48	71	937.4	12.459	-32.93	131	1606.2	9.608	-53.68
12	163.2	13.548	-8.67	72	949.9	12.426	-33.54	132	1615.8	9.554	-53.48
13	176.7	13.540	-8.87	73	962.3	12.392	-34.16	133	1625.3	9.501	-53.26
14	190.2	13.531	-9.06	74	974.7	12.358	-34.78	134	1634.8	9.448	-53.02
15	203.8	13.522	-9.27	75	987.0	12.323	-35.40	135	1644.2	9.395	-52.76
16	217.3	13.512	-9.47	76	999.3	12.287	-36.02	136	1653.5	9.342	-52.47
17	230.8	13.503	-9.69	77	1011.6	12.251	-36.63	137	1662.9	9.290	-52.17
18	244.3	13.493	-9.90	78	1023.8	12.214	-37.25	138	1672.1	9.238	-51.84
19	257.8	13.483	-10.13	79	1036.0	12.176	-37.86	139	1681.3	9.186	-51.49
20	271.2	13.473	-10.36	80	1048.2	12.138	-38.48	140	1690.5	9.135	-51.13
21	284.7	13.462	-10.59	81	1060.3	12.099	-39.08	141	1699.6	9.084	-50.74
22	298.2	13.451	-10.84	82	1072.4	12.060	-39.69	142	1708.7	9.034	-50.33
23	311.6	13.440	-11.09	83	1084.4	12.020	-40.29	143	1717.7	8.983	-49.91
24	325.1	13.429	-11.34	84	1096.4	11.979	-40.89	144	1726.6	8.934	-49.46
25	338.5	13.418	-11.61	85	1108.4	11.938	-41.48	145	1735.5	8.885	-49.00
26	351.9	13.406	-11.88	86	1120.3	11.896	-42.06	146	1744.4	8.836	-48.52
27	365.3	13.394	-12.16	87	1132.2	11.854	-42.64	147	1753.2	8.788	-48.02
28	378.7	13.382	-12.45	88	1144.0	11.811	-43.21	148	1762.0	8.740	-47.50
29	392.0	13.369	-12.75	89	1155.8	11.767	-43.77	149	1770.7	8.693	-46.97
30	405.4	13.356	-13.05	90	1167.5	11.723	-44.33	150	1779.4	8.646	-46.42
31	418.8	13.343	-13.36	91	1179.2	11.679	-44.87	151	1788.0	8.600	-45.86
32	432.1	13.329	-13.68	92	1190.9	11.634	-45.41	152	1796.6	8.554	-45.28
33	445.4	13.316	-14.01	93	1202.5	11.588	-45.94	153	1805.1	8.509	-44.69
34	458.7	13.301	-14.35	94	1214.1	11.542	-46.45	154	1813.6	8.465	-44.08
35	472.0	13.287	-14.70	95	1225.6	11.495	-46.95	155	1822.0	8.421	-43.46
36	485.3	13.272	-15.06	96	1237.0	11.448	-47.45	156	1830.4	8.378	-42.82
37	498.6	13.257	-15.43	97	1248.5	11.400	-47.93	157	1838.8	8.335	-42.18
38	511.8	13.241	-15.80	98	1259.8	11.352	-48.39	158	1847.1	8.293	-41.52
39	525.0	13.225	-16.19	99	1271.2	11.303	-48.85	159	1855.4	8.252	-40.85
40	538.3	13.209	-16.58	100	1282.4	11.254	-49.29	160	1863.6	8.212	-40.17
41	551.5	13.192	-16.99	101	1293.7	11.205	-49.71	161	1871.8	8.172	-39.48
42	564.7	13.175	-17.40	102	1304.9	11.155	-50.12	162	1879.9	8.133	-38.78
43	577.8	13.157	-17.82	103	1316.0	11.105	-50.51	163	1888.1	8.094	-38.07
44	591.0	13.139	-18.26	104	1327.1	11.054	-50.89	164	1896.1	8.057	-37.35
45	604.1	13.121	-18.70	105	1338.1	11.003	-51.25	165	1904.2	8.020	-36.63
46	617.2	13.102	-19.15	106	1349.1	10.951	-51.59	166	1912.2	7.983	-35.90
47	630.3	13.082	-19.61	107	1360.0	10.900	-51.92	167	1920.1	7.948	-35.16
48	643.4	13.062	-20.08	108	1370.9	10.848	-52.23	168	1928.1	7.913	-34.42
49	656.4	13.042	-20.56	109	1381.7	10.795	-52.52	169	1936.0	7.879	-33.67
50	669.5	13.021	-21.05	110	1392.5	10.743	-52.79	170	1943.8	7.846	-32.92
51	682.5	13.000	-21.54	111	1403.2	10.690	-53.04	171	1951.7	7.813	-32.16
52	695.5	12.978	-22.05	112	1413.8	10.636	-53.28	172	1959.5	7.781	-31.41
53	708.4	12.956	-22.56	113	1424.5	10.583	-53.49	173	1967.2	7.750	-30.65
54	721.4	12.933	-23.08	114	1435.0	10.529	-53.68	174	1975.0	7.720	-29.88
55	734.3	12.910	-23.61	115	1445.5	10.476	-53.85	175	1982.7	7.691	-29.12
56	747.2	12.886	-24.15	116	1456.0	10.422	-54.01	176	1990.3	7.662	-28.36
57	760.1	12.862	-24.69	117	1466.4	10.368	-54.14	177	1998.0	7.634	-27.59
58	772.9	12.837	-25.25	118	1476.7	10.314	-54.25	178	2005.6	7.607	-26.83
59	785.7	12.811	-25.80	119	1487.0	10.259	-54.33	179	2013.2	7.580	-26.07
60	798.5	12.785	-26.37	120	1497.2	10.205	-54.40	180	2020.8	7.555	-25.31

TABLE 7.5.2. *Platinum, Pt-67, versus Type KN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	2020.8	7.555	-25.31	240	2451.7	7.102	3.40	300	2885.2	7.334	2.81
181	2028.3	7.530	-24.55	241	2458.8	7.106	3.53	301	2892.6	7.337	2.78
182	2035.8	7.506	-23.79	242	2466.0	7.109	3.65	302	2899.9	7.340	2.74
183	2043.3	7.482	-23.04	243	2473.1	7.113	3.76	303	2907.2	7.342	2.71
184	2050.8	7.459	-22.30	244	2480.2	7.117	3.86	304	2914.6	7.345	2.68
185	2058.2	7.437	-21.55	245	2487.3	7.121	3.95	305	2921.9	7.348	2.65
186	2065.7	7.416	-20.82	246	2494.4	7.125	4.03	306	2929.3	7.350	2.63
187	2073.1	7.396	-20.08	247	2501.5	7.129	4.11	307	2936.6	7.353	2.60
188	2080.5	7.376	-19.36	248	2508.7	7.133	4.17	308	2944.0	7.356	2.58
189	2087.8	7.357	-18.64	249	2515.8	7.137	4.23	309	2951.3	7.358	2.56
190	2095.2	7.339	-17.93	250	2523.0	7.141	4.29	310	2958.7	7.361	2.54
191	2102.5	7.321	-17.22	251	2530.1	7.146	4.33	311	2966.1	7.363	2.52
192	2109.8	7.304	-16.53	252	2537.2	7.150	4.37	312	2973.4	7.366	2.50
193	2117.1	7.288	-15.84	253	2544.4	7.154	4.40	313	2980.8	7.368	2.49
194	2124.4	7.273	-15.16	254	2551.6	7.159	4.43	314	2988.2	7.371	2.48
195	2131.7	7.258	-14.49	255	2558.7	7.163	4.45	315	2995.5	7.373	2.47
196	2138.9	7.244	-13.83	256	2565.9	7.168	4.47	316	3002.9	7.376	2.46
197	2146.1	7.230	-13.18	257	2573.0	7.172	4.47	317	3010.3	7.378	2.45
198	2153.4	7.217	-12.53	258	2580.2	7.177	4.48	318	3017.7	7.381	2.45
199	2160.6	7.205	-11.90	259	2587.4	7.181	4.48	319	3025.0	7.383	2.44
200	2167.8	7.194	-11.28	260	2594.6	7.185	4.47	320	3032.4	7.386	2.44
201	2175.0	7.183	-10.68	261	2601.8	7.190	4.46	321	3039.8	7.388	2.44
202	2182.1	7.172	-10.08	262	2609.0	7.194	4.45	322	3047.2	7.390	2.44
203	2189.3	7.162	-9.49	263	2616.2	7.199	4.43	323	3054.6	7.393	2.45
204	2196.5	7.153	-8.92	264	2623.4	7.203	4.41	324	3062.0	7.395	2.45
205	2203.6	7.145	-8.36	265	2630.6	7.208	4.39	325	3069.4	7.398	2.46
206	2210.8	7.137	-7.81	266	2637.8	7.212	4.36	326	3076.8	7.400	2.47
207	2217.9	7.129	-7.27	267	2645.0	7.216	4.33	327	3084.2	7.403	2.48
208	2225.0	7.122	-6.74	268	2652.2	7.221	4.29	328	3091.6	7.405	2.49
209	2232.1	7.116	-6.23	269	2659.4	7.225	4.26	329	3099.0	7.408	2.50
210	2239.3	7.110	-5.73	270	2666.7	7.229	4.22	330	3106.4	7.410	2.52
211	2246.4	7.104	-5.24	271	2673.9	7.233	4.18	331	3113.8	7.413	2.53
212	2253.5	7.099	-4.77	272	2681.1	7.238	4.13	332	3121.2	7.415	2.55
213	2260.6	7.095	-4.31	273	2688.4	7.242	4.09	333	3128.6	7.418	2.57
214	2267.6	7.090	-3.86	274	2695.6	7.246	4.04	334	3136.1	7.420	2.59
215	2274.7	7.087	-3.42	275	2702.9	7.250	4.00	335	3143.5	7.423	2.61
216	2281.8	7.084	-3.00	276	2710.1	7.254	3.95	336	3150.9	7.426	2.63
217	2288.9	7.081	-2.59	277	2717.4	7.258	3.90	337	3158.3	7.428	2.66
218	2296.0	7.078	-2.20	278	2724.6	7.262	3.85	338	3165.8	7.431	2.68
219	2303.1	7.076	-1.81	279	2731.9	7.265	3.80	339	3173.2	7.434	2.71
220	2310.1	7.075	-1.44	280	2739.2	7.269	3.75	340	3180.6	7.436	2.73
221	2317.2	7.073	-1.09	281	2746.4	7.273	3.70	341	3188.1	7.439	2.76
222	2324.3	7.073	-0.74	282	2753.7	7.277	3.64	342	3195.5	7.442	2.79
223	2331.4	7.072	-0.41	283	2761.0	7.280	3.59	343	3202.9	7.445	2.82
224	2338.4	7.072	-0.09	284	2768.3	7.284	3.54	344	3210.4	7.447	2.85
225	2345.5	7.072	0.21	285	2775.5	7.287	3.49	345	3217.9	7.450	2.89
226	2352.6	7.072	0.51	286	2782.8	7.291	3.44	346	3225.3	7.453	2.92
227	2359.6	7.073	0.79	287	2790.1	7.294	3.39	347	3232.8	7.456	2.95
228	2366.7	7.074	1.06	288	2797.4	7.297	3.34	348	3240.2	7.459	2.99
229	2373.8	7.075	1.32	289	2804.7	7.301	3.29	349	3247.7	7.462	3.02
230	2380.9	7.076	1.56	290	2812.0	7.304	3.24	350	3255.1	7.465	3.06
231	2387.9	7.078	1.79	291	2819.3	7.307	3.19	351	3262.6	7.468	3.10
232	2395.0	7.080	2.02	292	2826.6	7.310	3.14	352	3270.1	7.471	3.14
233	2402.1	7.082	2.23	293	2834.0	7.314	3.10	353	3277.6	7.475	3.17
234	2409.2	7.084	2.43	294	2841.3	7.317	3.05	354	3285.0	7.478	3.21
235	2416.3	7.087	2.61	295	2848.6	7.320	3.01	355	3292.5	7.481	3.25
236	2423.4	7.090	2.79	296	2855.9	7.323	2.97	356	3300.0	7.484	3.29
237	2430.5	7.093	2.96	297	2863.2	7.326	2.93	357	3307.5	7.488	3.33
238	2437.5	7.096	3.12	298	2870.6	7.328	2.89	358	3315.0	7.491	3.37
239	2444.6	7.099	3.26	299	2877.9	7.331	2.85	359	3322.5	7.494	3.41
240	2451.7	7.102	3.40	300	2885.2	7.334	2.81	360	3330.0	7.498	3.46

TABLE 7.5.2. *Platinum, Pt-67, versus Type KN thermoelements*—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0°C —Continued

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	3330.0	7.498	3.46	420	3787.6	7.780	5.78	480	4265.5	8.156	6.45
361	3337.5	7.501	3.50	421	3795.4	7.786	5.81	481	4273.6	8.163	6.45
362	3345.0	7.505	3.54	422	3803.1	7.792	5.83	482	4281.8	8.169	6.44
363	3352.5	7.508	3.58	423	3810.9	7.797	5.86	483	4290.0	8.176	6.44
364	3360.0	7.512	3.63	424	3818.7	7.803	5.89	484	4298.1	8.182	6.43
365	3367.5	7.516	3.67	425	3826.5	7.809	5.91	485	4306.3	8.188	6.43
366	3375.0	7.519	3.71	426	3834.4	7.815	5.93	486	4314.5	8.195	6.42
367	3382.5	7.523	3.76	427	3842.2	7.821	5.96	487	4322.7	8.201	6.41
368	3390.1	7.527	3.80	428	3850.0	7.827	5.98	488	4330.9	8.208	6.41
369	3397.6	7.531	3.84	429	3857.8	7.833	6.00	489	4339.1	8.214	6.40
370	3405.1	7.534	3.89	430	3865.7	7.839	6.03	490	4347.3	8.220	6.39
371	3412.6	7.538	3.93	431	3873.5	7.845	6.05	491	4355.6	8.227	6.38
372	3420.2	7.542	3.98	432	3881.4	7.851	6.07	492	4363.8	8.233	6.37
373	3427.7	7.546	4.02	433	3889.2	7.857	6.09	493	4372.0	8.240	6.36
374	3435.3	7.550	4.06	434	3897.1	7.863	6.11	494	4380.3	8.246	6.35
375	3442.8	7.554	4.11	435	3904.9	7.869	6.13	495	4388.5	8.252	6.34
376	3450.4	7.559	4.15	436	3912.8	7.875	6.15	496	4396.8	8.259	6.33
377	3458.0	7.563	4.19	437	3920.7	7.882	6.16	497	4405.0	8.265	6.32
378	3465.5	7.567	4.24	438	3928.6	7.888	6.18	498	4413.3	8.271	6.31
379	3473.1	7.571	4.28	439	3936.5	7.894	6.20	499	4421.6	8.278	6.30
380	3480.7	7.576	4.33	440	3944.4	7.900	6.21	500	4429.9	8.284	6.29
381	3488.2	7.580	4.37	441	3952.3	7.906	6.23	501	4438.1	8.290	6.27
382	3495.8	7.584	4.41	442	3960.2	7.913	6.25	502	4446.4	8.296	6.26
383	3503.4	7.589	4.45	443	3968.1	7.919	6.26	503	4454.7	8.303	6.25
384	3511.0	7.593	4.50	444	3976.0	7.925	6.28	504	4463.0	8.309	6.23
385	3518.6	7.598	4.54	445	3983.9	7.931	6.29	505	4471.4	8.315	6.22
386	3526.2	7.602	4.58	446	3991.9	7.938	6.30	506	4479.7	8.321	6.20
387	3533.8	7.607	4.62	447	3999.8	7.944	6.32	507	4488.0	8.328	6.19
388	3541.4	7.612	4.67	448	4007.8	7.950	6.33	508	4496.3	8.334	6.17
389	3549.0	7.616	4.71	449	4015.7	7.957	6.34	509	4504.7	8.340	6.16
390	3556.6	7.621	4.75	450	4023.7	7.963	6.35	510	4513.0	8.346	6.14
391	3564.3	7.626	4.79	451	4031.6	7.969	6.36	511	4521.4	8.352	6.13
392	3571.9	7.630	4.83	452	4039.6	7.976	6.37	512	4529.7	8.358	6.11
393	3579.5	7.635	4.87	453	4047.6	7.982	6.38	513	4538.1	8.364	6.09
394	3587.2	7.640	4.91	454	4055.6	7.989	6.39	514	4546.4	8.370	6.08
395	3594.8	7.645	4.95	455	4063.6	7.995	6.40	515	4554.8	8.377	6.06
396	3602.4	7.650	4.99	456	4071.6	8.001	6.41	516	4563.2	8.383	6.04
397	3610.1	7.655	5.02	457	4079.6	8.008	6.41	517	4571.6	8.389	6.02
398	3617.8	7.660	5.06	458	4087.6	8.014	6.42	518	4580.0	8.395	6.00
399	3625.4	7.665	5.10	459	4095.6	8.021	6.43	519	4588.4	8.401	5.98
400	3633.1	7.670	5.14	460	4103.6	8.027	6.43	520	4596.8	8.407	5.96
401	3640.8	7.676	5.17	461	4111.7	8.033	6.44	521	4605.2	8.413	5.94
402	3648.4	7.681	5.21	462	4119.7	8.040	6.44	522	4613.6	8.418	5.92
403	3656.1	7.686	5.25	463	4127.7	8.046	6.45	523	4622.0	8.424	5.90
404	3663.8	7.691	5.28	464	4135.8	8.053	6.45	524	4630.4	8.430	5.88
405	3671.5	7.697	5.32	465	4143.8	8.059	6.46	525	4638.9	8.436	5.86
406	3679.2	7.702	5.35	466	4151.9	8.066	6.46	526	4647.3	8.442	5.84
407	3686.9	7.707	5.38	467	4160.0	8.072	6.46	527	4655.8	8.448	5.82
408	3694.6	7.713	5.42	468	4168.0	8.079	6.46	528	4664.2	8.454	5.80
409	3702.3	7.718	5.45	469	4176.1	8.085	6.47	529	4672.7	8.459	5.78
410	3710.1	7.724	5.48	470	4184.2	8.092	6.47	530	4681.1	8.465	5.75
411	3717.8	7.729	5.52	471	4192.3	8.098	6.47	531	4689.6	8.471	5.73
412	3725.5	7.735	5.55	472	4200.4	8.105	6.47	532	4698.1	8.477	5.71
413	3733.3	7.740	5.58	473	4208.5	8.111	6.47	533	4706.6	8.482	5.68
414	3741.0	7.746	5.61	474	4216.6	8.117	6.47	534	4715.0	8.488	5.66
415	3748.7	7.751	5.64	475	4224.8	8.124	6.46	535	4723.5	8.494	5.64
416	3756.5	7.757	5.67	476	4232.9	8.130	6.46	536	4732.0	8.499	5.61
417	3764.3	7.763	5.70	477	4241.0	8.137	6.46	537	4740.5	8.505	5.59
418	3772.0	7.768	5.73	478	4249.2	8.143	6.46	538	4749.0	8.510	5.56
419	3779.8	7.774	5.75	479	4257.3	8.150	6.45	539	4757.6	8.516	5.54
420	3787.6	7.780	5.78	480	4265.5	8.156	6.45	540	4766.1	8.522	5.51

TABLE 7.5.2. *Platinum, Pt-67, versus Type KN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	4766.1	8.522	5.51	600	5286.2	8.798	3.61	660	5819.3	8.949	1.40
541	4774.6	8.527	5.49	601	5295.0	8.802	3.58	661	5828.3	8.950	1.36
542	4783.1	8.533	5.46	602	5303.8	8.805	3.54	662	5837.2	8.951	1.32
543	4791.7	8.538	5.43	603	5312.7	8.809	3.50	663	5846.2	8.953	1.29
544	4800.2	8.543	5.41	604	5321.5	8.813	3.47	664	5855.1	8.954	1.25
545	4808.7	8.549	5.38	605	5330.3	8.816	3.43	665	5864.1	8.955	1.22
546	4817.3	8.554	5.35	606	5339.1	8.819	3.40	666	5873.0	8.956	1.18
547	4825.9	8.559	5.33	607	5347.9	8.823	3.36	667	5882.0	8.958	1.14
548	4834.4	8.565	5.30	608	5356.7	8.826	3.32	668	5891.0	8.959	1.11
549	4843.0	8.570	5.27	609	5365.6	8.829	3.29	669	5899.9	8.960	1.07
550	4851.6	8.575	5.24	610	5374.4	8.833	3.25	670	5908.9	8.961	1.04
551	4860.1	8.581	5.21	611	5383.2	8.836	3.21	671	5917.8	8.962	1.00
552	4868.7	8.586	5.19	612	5392.1	8.839	3.18	672	5926.8	8.963	0.96
553	4877.3	8.591	5.16	613	5400.9	8.842	3.14	673	5935.8	8.964	0.93
554	4885.9	8.596	5.13	614	5409.8	8.845	3.10	674	5944.7	8.965	0.89
555	4894.5	8.601	5.10	615	5418.6	8.848	3.07	675	5953.7	8.966	0.86
556	4903.1	8.606	5.07	616	5427.5	8.851	3.03	676	5962.7	8.966	0.82
557	4911.7	8.611	5.04	617	5436.3	8.854	2.99	677	5971.6	8.967	0.79
558	4920.3	8.616	5.01	618	5445.2	8.857	2.95	678	5980.6	8.968	0.75
559	4928.9	8.621	4.98	619	5454.0	8.860	2.92	679	5989.6	8.969	0.72
560	4937.6	8.626	4.95	620	5462.9	8.863	2.88	680	5998.5	8.970	0.68
561	4946.2	8.631	4.92	621	5471.7	8.866	2.84	681	6007.5	8.970	0.65
562	4954.8	8.636	4.89	622	5480.6	8.869	2.81	682	6016.5	8.971	0.61
563	4963.5	8.641	4.86	623	5489.5	8.872	2.77	683	6025.4	8.971	0.58
564	4972.1	8.646	4.83	624	5498.4	8.875	2.73	684	6034.4	8.972	0.54
565	4980.8	8.651	4.80	625	5507.2	8.877	2.69	685	6043.4	8.972	0.51
566	4989.4	8.655	4.77	626	5516.1	8.880	2.66	686	6052.4	8.973	0.47
567	4998.1	8.660	4.73	627	5525.0	8.883	2.62	687	6061.3	8.973	0.44
568	5006.7	8.665	4.70	628	5533.9	8.885	2.58	688	6070.3	8.974	0.41
569	5015.4	8.670	4.67	629	5542.8	8.888	2.55	689	6079.3	8.974	0.37
570	5024.1	8.674	4.64	630	5551.7	8.890	2.51	690	6088.3	8.975	0.34
571	5032.8	8.679	4.61	631	5560.5	8.893	2.47	691	6097.2	8.975	0.30
572	5041.4	8.684	4.57	632	5569.4	8.895	2.43	692	6106.2	8.975	0.27
573	5050.1	8.688	4.54	633	5578.3	8.898	2.40	693	6115.2	8.975	0.24
574	5058.8	8.693	4.51	634	5587.2	8.900	2.36	694	6124.2	8.976	0.20
575	5067.5	8.697	4.48	635	5596.1	8.902	2.32	695	6133.1	8.976	0.17
576	5076.2	8.702	4.44	636	5605.0	8.905	2.28	696	6142.1	8.976	0.14
577	5084.9	8.706	4.41	637	5613.9	8.907	2.25	697	6151.1	8.976	0.10
578	5093.6	8.710	4.38	638	5622.9	8.909	2.21	698	6160.1	8.976	0.07
579	5102.3	8.715	4.34	639	5631.8	8.911	2.17	699	6169.0	8.976	0.04
580	5111.0	8.719	4.31	640	5640.7	8.913	2.14	700	6178.0	8.976	0.01
581	5119.8	8.723	4.28	641	5649.6	8.916	2.10	701	6187.0	8.976	-0.03
582	5128.5	8.728	4.24	642	5658.5	8.918	2.06	702	6196.0	8.976	-0.06
583	5137.2	8.732	4.21	643	5667.4	8.920	2.02	703	6204.9	8.976	-0.09
584	5146.0	8.736	4.17	644	5676.3	8.922	1.99	704	6213.9	8.976	-0.12
585	5154.7	8.740	4.14	645	5685.3	8.924	1.95	705	6222.9	8.976	-0.16
586	5163.4	8.744	4.11	646	5694.2	8.926	1.91	706	6231.9	8.976	-0.19
587	5172.2	8.748	4.07	647	5703.1	8.927	1.88	707	6240.8	8.976	-0.22
588	5180.9	8.752	4.04	648	5712.0	8.929	1.84	708	6249.8	8.975	-0.25
589	5189.7	8.756	4.00	649	5721.0	8.931	1.80	709	6258.8	8.975	-0.28
590	5198.4	8.760	3.97	650	5729.9	8.933	1.76	710	6267.8	8.975	-0.32
591	5207.2	8.764	3.93	651	5738.8	8.935	1.73	711	6276.7	8.974	-0.35
592	5216.0	8.768	3.90	652	5747.8	8.936	1.69	712	6285.7	8.974	-0.38
593	5224.7	8.772	3.86	653	5756.7	8.938	1.65	713	6294.7	8.974	-0.41
594	5233.5	8.776	3.83	654	5765.7	8.940	1.62	714	6303.7	8.973	-0.44
595	5242.3	8.780	3.79	655	5774.6	8.941	1.58	715	6312.6	8.973	-0.47
596	5251.1	8.784	3.76	656	5783.5	8.943	1.54	716	6321.6	8.972	-0.50
597	5259.9	8.787	3.72	657	5792.5	8.944	1.51	717	6330.6	8.972	-0.53
598	5268.7	8.791	3.68	658	5801.4	8.946	1.47	718	6339.6	8.971	-0.56
599	5277.4	8.795	3.65	659	5810.4	8.947	1.43	719	6348.5	8.971	-0.59
600	5286.2	8.798	3.61	660	5819.3	8.949	1.40	720	6357.5	8.970	-0.62

TABLE 7.5.2. *Platinum, Pt-67, versus Type KN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	6357.5	8.970	-0.62	780	6893.6	8.884	-2.13	840	7422.2	8.726	-3.04
721	6366.5	8.969	-0.65	781	6902.5	8.882	-2.15	841	7430.9	8.723	-3.05
722	6375.4	8.969	-0.68	782	6911.3	8.880	-2.17	842	7439.6	8.720	-3.06
723	6384.4	8.968	-0.71	783	6920.2	8.878	-2.19	843	7448.3	8.717	-3.07
724	6393.4	8.967	-0.74	784	6929.1	8.876	-2.21	844	7457.1	8.714	-3.08
725	6402.3	8.967	-0.77	785	6938.0	8.874	-2.23	845	7465.8	8.711	-3.09
726	6411.3	8.966	-0.80	786	6946.8	8.871	-2.25	846	7474.5	8.708	-3.10
727	6420.3	8.965	-0.83	787	6955.7	8.869	-2.27	847	7483.2	8.705	-3.11
728	6429.2	8.964	-0.86	788	6964.6	8.867	-2.29	848	7491.9	8.702	-3.12
729	6438.2	8.963	-0.89	789	6973.5	8.864	-2.31	849	7500.6	8.699	-3.13
730	6447.2	8.962	-0.91	790	6982.3	8.862	-2.32	850	7509.3	8.695	-3.14
731	6456.1	8.961	-0.94	791	6991.2	8.860	-2.34	851	7518.0	8.692	-3.14
732	6465.1	8.960	-0.97	792	7000.0	8.857	-2.36	852	7526.7	8.689	-3.15
733	6474.0	8.959	-1.00	793	7008.9	8.855	-2.38	853	7535.4	8.686	-3.16
734	6483.0	8.958	-1.03	794	7017.7	8.853	-2.40	854	7544.0	8.683	-3.17
735	6492.0	8.957	-1.05	795	7026.6	8.850	-2.41	855	7552.7	8.680	-3.18
736	6500.9	8.956	-1.08	796	7035.4	8.848	-2.43	856	7561.4	8.677	-3.19
737	6509.9	8.955	-1.11	797	7044.3	8.845	-2.45	857	7570.1	8.673	-3.20
738	6518.8	8.954	-1.14	798	7053.1	8.843	-2.47	858	7578.8	8.670	-3.20
739	6527.8	8.953	-1.16	799	7062.0	8.840	-2.48	859	7587.4	8.667	-3.21
740	6536.7	8.952	-1.19	800	7070.8	8.838	-2.50	860	7596.1	8.664	-3.22
741	6545.7	8.951	-1.22	801	7079.7	8.835	-2.52	861	7604.7	8.660	-3.23
742	6554.6	8.949	-1.24	802	7088.5	8.833	-2.53	862	7613.4	8.657	-3.24
743	6563.6	8.948	-1.27	803	7097.3	8.830	-2.55	863	7622.1	8.654	-3.24
744	6572.5	8.947	-1.30	804	7106.2	8.828	-2.57	864	7630.7	8.651	-3.25
745	6581.5	8.946	-1.32	805	7115.0	8.825	-2.58	865	7639.4	8.648	-3.26
746	6590.4	8.944	-1.35	806	7123.8	8.823	-2.60	866	7648.0	8.644	-3.26
747	6599.4	8.943	-1.38	807	7132.6	8.820	-2.61	867	7656.7	8.641	-3.27
748	6608.3	8.941	-1.40	808	7141.4	8.817	-2.63	868	7665.3	8.638	-3.28
749	6617.2	8.940	-1.43	809	7150.3	8.815	-2.64	869	7673.9	8.634	-3.29
750	6626.2	8.939	-1.45	810	7159.1	8.812	-2.66	870	7682.6	8.631	-3.29
751	6635.1	8.937	-1.48	811	7167.9	8.810	-2.67	871	7691.2	8.628	-3.30
752	6644.1	8.936	-1.50	812	7176.7	8.807	-2.69	872	7699.8	8.625	-3.30
753	6653.0	8.934	-1.53	813	7185.5	8.804	-2.70	873	7708.4	8.621	-3.31
754	6661.9	8.933	-1.55	814	7194.3	8.801	-2.72	874	7717.1	8.618	-3.32
755	6670.9	8.931	-1.58	815	7203.1	8.799	-2.73	875	7725.7	8.615	-3.32
756	6679.8	8.929	-1.60	816	7211.9	8.796	-2.75	876	7734.3	8.611	-3.33
757	6688.7	8.928	-1.62	817	7220.7	8.793	-2.76	877	7742.9	8.608	-3.34
758	6697.6	8.926	-1.65	818	7229.5	8.790	-2.77	878	7751.5	8.605	-3.34
759	6706.6	8.925	-1.67	819	7238.3	8.788	-2.79	879	7760.1	8.601	-3.35
760	6715.5	8.923	-1.70	820	7247.1	8.785	-2.80	880	7768.7	8.598	-3.35
761	6724.4	8.921	-1.72	821	7255.8	8.782	-2.81	881	7777.3	8.595	-3.36
762	6733.3	8.919	-1.74	822	7264.6	8.779	-2.83	882	7785.9	8.591	-3.36
763	6742.3	8.918	-1.77	823	7273.4	8.776	-2.84	883	7794.5	8.588	-3.37
764	6751.2	8.916	-1.79	824	7282.2	8.774	-2.85	884	7803.1	8.584	-3.37
765	6760.1	8.914	-1.81	825	7290.9	8.771	-2.87	885	7811.7	8.581	-3.38
766	6769.0	8.912	-1.83	826	7299.7	8.768	-2.88	886	7820.2	8.578	-3.38
767	6777.9	8.910	-1.86	827	7308.5	8.765	-2.89	887	7828.8	8.574	-3.39
768	6786.8	8.909	-1.88	828	7317.2	8.762	-2.90	888	7837.4	8.571	-3.39
769	6795.7	8.907	-1.90	829	7326.0	8.759	-2.92	889	7846.0	8.568	-3.40
770	6804.6	8.905	-1.92	830	7334.8	8.756	-2.93	890	7854.5	8.564	-3.40
771	6813.5	8.903	-1.94	831	7343.5	8.753	-2.94	891	7863.1	8.561	-3.41
772	6822.4	8.901	-1.97	832	7352.3	8.750	-2.95	892	7871.6	8.557	-3.41
773	6831.3	8.899	-1.99	833	7361.0	8.747	-2.96	893	7880.2	8.554	-3.42
774	6840.2	8.897	-2.01	834	7369.8	8.744	-2.97	894	7888.7	8.550	-3.42
775	6849.1	8.895	-2.03	835	7378.5	8.741	-2.98	895	7897.3	8.547	-3.43
776	6858.0	8.893	-2.05	836	7387.2	8.738	-3.00	896	7905.8	8.544	-3.43
777	6866.9	8.891	-2.07	837	7396.0	8.735	-3.01	897	7914.4	8.540	-3.43
778	6875.8	8.889	-2.09	838	7404.7	8.732	-3.02	898	7922.9	8.537	-3.44
779	6884.7	8.887	-2.11	839	7413.5	8.729	-3.03	899	7931.5	8.533	-3.44
780	6893.6	8.884	-2.13	840	7422.2	8.726	-3.04	900	7940.0	8.530	-3.45

TABLE 7.5.2. *Platinum, Pt-67, versus Type KN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	7940.0	8.530	-3.45	960	8445.5	8.318	-3.60	1020	8938.0	8.097	-3.78
901	7948.5	8.526	-3.45	961	8453.8	8.314	-3.60	1021	8946.1	8.093	-3.79
902	7957.0	8.523	-3.45	962	8462.1	8.311	-3.61	1022	8954.2	8.090	-3.79
903	7965.6	8.519	-3.46	963	8470.4	8.307	-3.61	1023	8962.2	8.086	-3.80
904	7974.1	8.516	-3.46	964	8478.7	8.303	-3.61	1024	8970.3	8.082	-3.80
905	7982.6	8.513	-3.47	965	8487.0	8.300	-3.61	1025	8978.4	8.078	-3.81
906	7991.1	8.509	-3.47	966	8495.3	8.296	-3.61	1026	8986.5	8.074	-3.81
907	7999.6	8.506	-3.47	967	8503.6	8.293	-3.62	1027	8994.6	8.070	-3.82
908	8008.1	8.502	-3.48	968	8511.9	8.289	-3.62	1028	9002.6	8.067	-3.82
909	8016.6	8.499	-3.48	969	8520.2	8.285	-3.62	1029	9010.7	8.063	-3.83
910	8025.1	8.495	-3.48	970	8528.5	8.282	-3.62	1030	9018.7	8.059	-3.83
911	8033.6	8.492	-3.49	971	8536.7	8.278	-3.63	1031	9026.8	8.055	-3.84
912	8042.1	8.488	-3.49	972	8545.0	8.274	-3.63	1032	9034.9	8.051	-3.84
913	8050.6	8.485	-3.49	973	8553.3	8.271	-3.63	1033	9042.9	8.047	-3.85
914	8059.1	8.481	-3.49	974	8561.6	8.267	-3.63	1034	9051.0	8.044	-3.85
915	8067.5	8.478	-3.50	975	8569.8	8.264	-3.63	1035	9059.0	8.040	-3.86
916	8076.0	8.474	-3.50	976	8578.1	8.260	-3.64	1036	9067.0	8.036	-3.86
917	8084.5	8.471	-3.50	977	8586.3	8.256	-3.64	1037	9075.1	8.032	-3.87
918	8093.0	8.467	-3.51	978	8594.6	8.253	-3.64	1038	9083.1	8.028	-3.87
919	8101.4	8.464	-3.51	979	8602.8	8.249	-3.64	1039	9091.1	8.024	-3.88
920	8109.9	8.460	-3.51	980	8611.1	8.245	-3.65	1040	9099.1	8.020	-3.89
921	8118.3	8.457	-3.51	981	8619.3	8.242	-3.65	1041	9107.2	8.017	-3.89
922	8126.8	8.453	-3.52	982	8627.6	8.238	-3.65	1042	9115.2	8.013	-3.90
923	8135.3	8.450	-3.52	983	8635.8	8.234	-3.65	1043	9123.2	8.009	-3.90
924	8143.7	8.446	-3.52	984	8644.0	8.231	-3.66	1044	9131.2	8.005	-3.91
925	8152.1	8.443	-3.53	985	8652.3	8.227	-3.66	1045	9139.2	8.001	-3.92
926	8160.6	8.439	-3.53	986	8660.5	8.223	-3.66	1046	9147.2	7.997	-3.92
927	8169.0	8.436	-3.53	987	8668.7	8.220	-3.67	1047	9155.2	7.993	-3.93
928	8177.5	8.432	-3.53	988	8676.9	8.216	-3.67	1048	9163.2	7.989	-3.93
929	8185.9	8.429	-3.54	989	8685.2	8.212	-3.67	1049	9171.2	7.985	-3.94
930	8194.3	8.425	-3.54	990	8693.4	8.209	-3.67	1050	9179.2	7.981	-3.95
931	8202.7	8.421	-3.54	991	8701.6	8.205	-3.68	1051	9187.1	7.977	-3.95
932	8211.2	8.418	-3.54	992	8709.8	8.201	-3.68	1052	9195.1	7.973	-3.96
933	8219.6	8.414	-3.54	993	8718.0	8.198	-3.68	1053	9203.1	7.969	-3.97
934	8228.0	8.411	-3.55	994	8726.2	8.194	-3.69	1054	9211.0	7.965	-3.97
935	8236.4	8.407	-3.55	995	8734.4	8.190	-3.69	1055	9219.0	7.961	-3.98
936	8244.8	8.404	-3.55	996	8742.6	8.187	-3.69	1056	9227.0	7.957	-3.99
937	8253.2	8.400	-3.55	997	8750.7	8.183	-3.69	1057	9234.9	7.953	-3.99
938	8261.6	8.397	-3.56	998	8758.9	8.179	-3.70	1058	9242.9	7.949	-4.00
939	8270.0	8.393	-3.56	999	8767.1	8.176	-3.70	1059	9250.8	7.945	-4.01
940	8278.4	8.389	-3.56	1000	8775.3	8.172	-3.70	1060	9258.8	7.941	-4.01
941	8286.8	8.386	-3.56	1001	8783.4	8.168	-3.71	1061	9266.7	7.937	-4.02
942	8295.2	8.382	-3.56	1002	8791.6	8.165	-3.71	1062	9274.6	7.933	-4.03
943	8303.5	8.379	-3.57	1003	8799.8	8.161	-3.72	1063	9282.6	7.929	-4.04
944	8311.9	8.375	-3.57	1004	8807.9	8.157	-3.72	1064	9290.5	7.925	-4.04
945	8320.3	8.372	-3.57	1005	8816.1	8.153	-3.72	1065	9298.4	7.921	-4.05
946	8328.7	8.368	-3.57	1006	8824.2	8.150	-3.73	1066	9306.3	7.917	-4.06
947	8337.0	8.365	-3.57	1007	8832.4	8.146	-3.73	1067	9314.3	7.913	-4.06
948	8345.4	8.361	-3.58	1008	8840.5	8.142	-3.73	1068	9322.2	7.909	-4.07
949	8353.7	8.357	-3.58	1009	8848.7	8.138	-3.74	1069	9330.1	7.905	-4.08
950	8362.1	8.354	-3.58	1010	8856.8	8.135	-3.74	1070	9338.0	7.901	-4.09
951	8370.5	8.350	-3.58	1011	8864.9	8.131	-3.75	1071	9345.9	7.897	-4.09
952	8378.8	8.347	-3.58	1012	8873.1	8.127	-3.75	1072	9353.8	7.893	-4.10
953	8387.1	8.343	-3.59	1013	8881.2	8.123	-3.75	1073	9361.7	7.889	-4.11
954	8395.5	8.339	-3.59	1014	8889.3	8.120	-3.76	1074	9369.6	7.885	-4.12
955	8403.8	8.336	-3.59	1015	8897.4	8.116	-3.76	1075	9377.4	7.880	-4.12
956	8412.2	8.332	-3.59	1016	8905.5	8.112	-3.77	1076	9385.3	7.876	-4.13
957	8420.5	8.329	-3.60	1017	8913.7	8.108	-3.77	1077	9393.2	7.872	-4.14
958	8428.8	8.325	-3.60	1018	8921.8	8.105	-3.77	1078	9401.1	7.868	-4.15
959	8437.1	8.321	-3.60	1019	8929.9	8.101	-3.78	1079	9408.9	7.864	-4.16
960	8445.5	8.318	-3.60	1020	8938.0	8.097	-3.78	1080	9416.8	7.860	-4.16

TABLE 7.5.2. Platinum, Pt-67, versus Type KN thermoelements—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1080	9416.8	7.860	-4.16	1140	9880.6	7.596	-4.62	1200	10327.9	7.316	-4.50
1081	9424.6	7.856	-4.17	1141	9888.2	7.591	-4.62	1201	10335.2	7.312	-4.49
1082	9432.5	7.851	-4.18	1142	9895.8	7.586	-4.63	1202	10342.5	7.307	-4.47
1083	9440.3	7.847	-4.19	1143	9903.3	7.582	-4.64	1203	10349.8	7.303	-4.46
1084	9448.2	7.843	-4.20	1144	9910.9	7.577	-4.64	1204	10357.1	7.298	-4.44
1085	9456.0	7.839	-4.20	1145	9918.5	7.572	-4.65	1205	10364.4	7.294	-4.43
1086	9463.9	7.835	-4.21	1146	9926.1	7.568	-4.65	1206	10371.7	7.290	-4.41
1087	9471.7	7.830	-4.22	1147	9933.6	7.563	-4.65	1207	10379.0	7.285	-4.39
1088	9479.5	7.826	-4.23	1148	9941.2	7.558	-4.66	1208	10386.3	7.281	-4.38
1089	9487.4	7.822	-4.24	1149	9948.8	7.554	-4.66	1209	10393.6	7.276	-4.36
1090	9495.2	7.818	-4.24	1150	9956.3	7.549	-4.67	1210	10400.9	7.272	-4.34
1091	9503.0	7.813	-4.25	1151	9963.9	7.544	-4.67	1211	10408.1	7.268	-4.32
1092	9510.8	7.809	-4.26	1152	9971.4	7.540	-4.67	1212	10415.4	7.263	-4.30
1093	9518.6	7.805	-4.27	1153	9978.9	7.535	-4.68	1213	10422.7	7.259	-4.28
1094	9526.4	7.801	-4.28	1154	9986.5	7.530	-4.68	1214	10429.9	7.255	-4.26
1095	9534.2	7.796	-4.28	1155	9994.0	7.526	-4.68	1215	10437.2	7.251	-4.23
1096	9542.0	7.792	-4.29	1156	10001.5	7.521	-4.69	1216	10444.4	7.246	-4.21
1097	9549.8	7.788	-4.30	1157	10009.0	7.516	-4.69	1217	10451.7	7.242	-4.19
1098	9557.6	7.783	-4.31	1158	10016.6	7.512	-4.69	1218	10458.9	7.238	-4.16
1099	9565.4	7.779	-4.32	1159	10024.1	7.507	-4.69	1219	10466.1	7.234	-4.14
1100	9573.1	7.775	-4.33	1160	10031.6	7.502	-4.70	1220	10473.4	7.230	-4.11
1101	9580.9	7.771	-4.33	1161	10039.1	7.498	-4.70	1221	10480.6	7.226	-4.09
1102	9588.7	7.766	-4.34	1162	10046.6	7.493	-4.70	1222	10487.8	7.222	-4.06
1103	9596.4	7.762	-4.35	1163	10054.0	7.488	-4.70	1223	10495.0	7.218	-4.03
1104	9604.2	7.757	-4.36	1164	10061.5	7.484	-4.70	1224	10502.2	7.214	-4.00
1105	9612.0	7.753	-4.37	1165	10069.0	7.479	-4.70	1225	10509.5	7.210	-3.97
1106	9619.7	7.749	-4.37	1166	10076.5	7.474	-4.70	1226	10516.7	7.206	-3.94
1107	9627.5	7.744	-4.38	1167	10084.0	7.469	-4.70	1227	10523.9	7.202	-3.91
1108	9635.2	7.740	-4.39	1168	10091.4	7.465	-4.70	1228	10531.1	7.198	-3.88
1109	9642.9	7.736	-4.40	1169	10098.9	7.460	-4.70	1229	10538.3	7.194	-3.85
1110	9650.7	7.731	-4.41	1170	10106.4	7.455	-4.70	1230	10545.5	7.190	-3.82
1111	9658.4	7.727	-4.42	1171	10113.8	7.451	-4.70	1231	10552.6	7.186	-3.78
1112	9666.1	7.722	-4.42	1172	10121.3	7.446	-4.70	1232	10559.8	7.183	-3.75
1113	9673.8	7.718	-4.43	1173	10128.7	7.441	-4.70	1233	10567.0	7.179	-3.71
1114	9681.6	7.713	-4.44	1174	10136.1	7.437	-4.69	1234	10574.2	7.175	-3.67
1115	9689.3	7.709	-4.45	1175	10143.6	7.432	-4.69	1235	10581.4	7.171	-3.64
1116	9697.0	7.705	-4.45	1176	10151.0	7.427	-4.69	1236	10588.5	7.168	-3.60
1117	9704.7	7.700	-4.46	1177	10158.4	7.422	-4.69	1237	10595.7	7.164	-3.56
1118	9712.4	7.696	-4.47	1178	10165.8	7.418	-4.68	1238	10602.9	7.161	-3.52
1119	9720.1	7.691	-4.48	1179	10173.3	7.413	-4.68	1239	10610.0	7.157	-3.48
1120	9727.8	7.687	-4.49	1180	10180.7	7.408	-4.67	1240	10617.2	7.154	-3.43
1121	9735.4	7.682	-4.49	1181	10188.1	7.404	-4.67	1241	10624.3	7.150	-3.39
1122	9743.1	7.678	-4.50	1182	10195.5	7.399	-4.66	1242	10631.5	7.147	-3.35
1123	9750.8	7.673	-4.51	1183	10202.9	7.394	-4.66	1243	10638.6	7.144	-3.30
1124	9758.5	7.669	-4.52	1184	10210.3	7.390	-4.65	1244	10645.8	7.140	-3.25
1125	9766.1	7.664	-4.52	1185	10217.7	7.385	-4.65	1245	10652.9	7.137	-3.21
1126	9773.8	7.660	-4.53	1186	10225.0	7.380	-4.64	1246	10660.0	7.134	-3.16
1127	9781.5	7.655	-4.54	1187	10232.4	7.376	-4.63	1247	10667.2	7.131	-3.11
1128	9789.1	7.651	-4.54	1188	10239.8	7.371	-4.63	1248	10674.3	7.128	-3.06
1129	9796.8	7.646	-4.55	1189	10247.2	7.367	-4.62	1249	10681.4	7.125	-3.01
1130	9804.4	7.641	-4.56	1190	10254.5	7.362	-4.61	1250	10688.5	7.122	-2.96
1131	9812.0	7.637	-4.56	1191	10261.9	7.357	-4.60	1251	10695.7	7.119	-2.90
1132	9819.7	7.632	-4.57	1192	10269.2	7.353	-4.59	1252	10702.8	7.116	-2.85
1133	9827.3	7.628	-4.58	1193	10276.6	7.348	-4.58	1253	10709.9	7.113	-2.79
1134	9834.9	7.623	-4.58	1194	10283.9	7.344	-4.57	1254	10717.0	7.110	-2.73
1135	9842.5	7.619	-4.59	1195	10291.3	7.339	-4.56	1255	10724.1	7.108	-2.68
1136	9850.2	7.614	-4.60	1196	10298.6	7.334	-4.55	1256	10731.2	7.105	-2.62
1137	9857.8	7.609	-4.60	1197	10305.9	7.330	-4.54	1257	10738.3	7.102	-2.56
1138	9865.4	7.605	-4.61	1198	10313.3	7.325	-4.53	1258	10745.4	7.100	-2.49
1139	9873.0	7.600	-4.61	1199	10320.6	7.321	-4.51	1259	10752.5	7.097	-2.43
1140	9880.6	7.596	-4.62	1200	10327.9	7.316	-4.50	1260	10759.6	7.095	-2.37

TABLE 7.5.2. *Platinum, Pt-67, versus Type KN thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
1260	10759.6	7.095	-2.37	1300	11042.4	7.067	1.38	1340	11327.7	7.246	8.22
1261	10766.7	7.093	-2.30	1301	11049.4	7.068	1.51	1341	11335.0	7.255	8.45
1262	10773.8	7.090	-2.24	1302	11056.5	7.070	1.64	1342	11342.2	7.263	8.67
1263	10780.9	7.088	-2.17	1303	11063.6	7.072	1.77	1343	11349.5	7.272	8.90
1264	10788.0	7.086	-2.10	1304	11070.6	7.073	1.90	1344	11356.8	7.281	9.13
1265	10795.1	7.084	-2.03	1305	11077.7	7.075	2.04	1345	11364.1	7.290	9.36
1266	10802.2	7.082	-1.96	1306	11084.8	7.078	2.18	1346	11371.4	7.300	9.60
1267	10809.2	7.080	-1.88	1307	11091.9	7.080	2.32	1347	11378.7	7.310	9.84
1268	10816.3	7.078	-1.81	1308	11099.0	7.082	2.46	1348	11386.0	7.320	10.08
1269	10823.4	7.076	-1.73	1309	11106.0	7.085	2.60	1349	11393.3	7.330	10.33
1270	10830.5	7.075	-1.66	1310	11113.1	7.087	2.75	1350	11400.6	7.340	10.58
1271	10837.5	7.073	-1.58	1311	11120.2	7.090	2.90	1351	11408.0	7.351	10.83
1272	10844.6	7.072	-1.50	1312	11127.3	7.093	3.05	1352	11415.3	7.362	11.09
1273	10851.7	7.070	-1.42	1313	11134.4	7.096	3.20	1353	11422.7	7.373	11.34
1274	10858.8	7.069	-1.33	1314	11141.5	7.100	3.36	1354	11430.1	7.385	11.61
1275	10865.8	7.068	-1.25	1315	11148.6	7.103	3.51	1355	11437.5	7.396	11.87
1276	10872.9	7.066	-1.16	1316	11155.7	7.107	3.67	1356	11444.9	7.408	12.14
1277	10880.0	7.065	-1.08	1317	11162.8	7.110	3.83	1357	11452.3	7.421	12.41
1278	10887.0	7.064	-0.99	1318	11169.9	7.114	4.00	1358	11459.7	7.433	12.68
1279	10894.1	7.063	-0.90	1319	11177.0	7.118	4.16	1359	11467.2	7.446	12.96
1280	10901.1	7.062	-0.81	1320	11184.2	7.123	4.33	1360	11474.6	7.459	13.24
1281	10908.2	7.062	-0.71	1321	11191.3	7.127	4.50	1361	11482.1	7.472	13.53
1282	10915.3	7.061	-0.62	1322	11198.4	7.132	4.68	1362	11489.6	7.486	13.81
1283	10922.3	7.060	-0.52	1323	11205.6	7.136	4.85	1363	11497.1	7.500	14.11
1284	10929.4	7.060	-0.42	1324	11212.7	7.141	5.03	1364	11504.6	7.514	14.40
1285	10936.5	7.060	-0.32	1325	11219.8	7.146	5.21	1365	11512.1	7.529	14.70
1286	10943.5	7.059	-0.22	1326	11227.0	7.152	5.39	1366	11519.6	7.544	15.00
1287	10950.6	7.059	-0.12	1327	11234.1	7.157	5.58	1367	11527.2	7.559	15.31
1288	10957.6	7.059	-0.01	1328	11241.3	7.163	5.77	1368	11534.7	7.574	15.61
1289	10964.7	7.059	0.09	1329	11248.5	7.169	5.96	1369	11542.3	7.590	15.93
1290	10971.7	7.059	0.20	1330	11255.6	7.175	6.15	1370	11549.9	7.606	16.24
1291	10978.8	7.059	0.31	1331	11262.8	7.181	6.34	1371	11557.5	7.623	16.56
1292	10985.9	7.060	0.42	1332	11270.0	7.187	6.54	1372	11565.2	7.639	16.88
1293	10992.9	7.060	0.53	1333	11277.2	7.194	6.74				
1294	11000.0	7.061	0.65	1334	11284.4	7.201	6.95				
1295	11007.0	7.062	0.77	1335	11291.6	7.208	7.15				
1296	11014.1	7.062	0.88	1336	11298.8	7.215	7.36				
1297	11021.2	7.063	1.01	1337	11306.0	7.223	7.57				
1298	11028.2	7.064	1.13	1338	11313.2	7.230	7.79				
1299	11035.3	7.066	1.25	1339	11320.5	7.238	8.00				
1300	11042.4	7.067	1.38	1340	11327.7	7.246	8.22				

TABLE 7.5.3. *Thermoelectric values at the fixed points for platinum, Pt-67, versus Type KN thermoelements*

Fixed point	Temp. °C	E μV	S μV/°C	dS/dT nV/°C ²
Helium NBP	-268.935	-2900.05	0.075	174.90
Hydrogen TP	-259.340	-2890.85	1.886	201.30
Hydrogen NBP	-252.870	-2874.36	3.218	208.30
Neon TP	-248.595	-2858.71	4.106	206.05
Neon NBP	-246.048	-2847.58	4.626	202.24
Oxygen TP	-218.789	-2656.72	8.908	103.02
Nitrogen TP	-210.002	-2574.89	9.672	72.10
Nitrogen NBP	-195.802	-2431.57	10.435	38.88
Oxygen NBP	-182.962	-2294.86	10.831	25.00
Carbon Dioxide SP	-78.476	-1052.44	12.917	18.04
Mercury FP	-38.862	-528.77	13.472	10.75
Ice point*	0.000	0.00	13.640	-6.59
Ether TP	26.870	363.6	13.396	-12.12
Water BP	100.000	1282.5	11.254	-49.29
Benzoic TP	122.370	1521.3	10.076	-54.47
Indium FP	156.634	1835.7	8.351	-42.41
Tin FP	231.9681	2394.8	7.080	2.01
Bismuth FP	271.442	2677.1	7.235	4.16
Cadmium FP	321.108	3040.6	7.388	2.44
Lead FP	327.502	3087.9	7.404	2.48
Mercury BP	356.660	3304.9	7.486	3.32
Zinc FP	419.580	3784.3	7.777	5.77
Sulphur BP	444.674	3981.4	7.929	6.28
Cu-Al FP	548.23	4836.4	8.566	5.29
Antimony FP	630.74	5558.2	8.892	2.48
Aluminum FP	660.37	5822.6	8.949	1.38
Silver FP	961.93	8461.5	8.311	-3.61
Gold FP	1064.43	9293.9	7.924	-4.05
Copper FP	1084.5	9452.1	7.841	-4.20

*Junction point of different functions.

TABLE 7.5.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of platinum, Pt-67, versus Type KN thermoelements*

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-270 to -200 °C	12	(*)	500	2	0.2	<0.01
-200 to 0 °C	12	(*)	70	0.2	0.02	<0.01
0 to 200 °C	8 + exp	1	0.04	<0.01	<0.01	<0.01
200 to 400 °C	8 + exp	4	0.07	<0.01	<0.01	<0.01
400 to 600 °C	8 + exp	20	0.8	<0.01	<0.01	<0.01
600 to 800 °C	8 + exp	90	3	<0.01	<0.01	<0.01
800 to 1000 °C	8 + exp	300	8	<0.01	<0.01	<0.01
1000 to 1200 °C	8 + exp	800	15	0.04	0.02	<0.01
1200 to 1372 °C	8 + exp	(*)	30	0.1	0.05	<0.01

*A high-order polynomial with a low-bit machine causes extreme error

8. TYPE T—Copper Versus Copper–Nickel Alloy Thermocouples

8.1. Material Specifications and Precautions

This type is one of the older and more popular thermocouples for determining temperatures within the range from about 300 °C down to the hydrogen normal boiling point (−252.87 °C). It is at present the only one of the standardized letter-designated type thermocouples for which limits of error are specified below 0 °C. The positive thermoelement, TP, is typically electrolytic tough pitch copper that conforms to ASTM Specification B3 for soft or annealed bare copper wire. Such material is about 99.95 percent pure copper with an oxygen content varying from 0.02 to 0.07 percent (depending on sulfur content) and with other impurities totaling about 0.01 percent. Above about −195 °C the thermoelectric properties of Type TP thermoelements, which satisfy the above conditions, are exceptionally uniform and exhibit little variation between different lots. Below about 76 K the thermoelectric properties are affected more strongly by the presence of dilute transition metal solutes, particularly iron.

The negative thermoelement, TN (or EN), is a copper-nickel alloy known ambiguously as constantan. As discussed in section 6.1, the word constantan refers to a family of copper-nickel alloys containing anywhere from 45 to 60 percent copper. These alloys also typically contain small percentages of manganese and iron as well as other trace impurities such as carbon, magnesium, silicon, cobalt, etc. Constantan is also known by various trade names such as Advance¹ and Cupron². The constantan for Type T thermocouples usually contains about 55 percent copper, 45 percent nickel, and small but thermoelectrically significant amounts of iron and manganese, about 0.1 percent or larger. **It should be emphasized that Type TN (or EN) thermoelements are NOT generally interchangeable with Type JN thermoelements, although they are all referred to as “constantan”.** In order to provide some differentiation in nomenclature, Type TN (or EN) is often referred to as Adams' constantan and Type JN is usually referred to as SAMA constantan.

The thermoelectric relations for Type TN and EN thermoelements are the same, that is the voltage versus temperature equations and tables for platinum versus Type TN thermoelements is typical for both types of thermoelements over the temperature range recommended for each corresponding thermocouple type. However, it should *not* be assumed that Type TN and EN thermoelements are always interchangeable or that they have the same commercial limits of error.

The first reference tables for Type T thermocouples to be used on an industry-wide basis were those prepared by Roeser and Dahl [1938]. They indicated that their tabular values were intended primarily for use above 0 °C. They presented tabular values below 0 °C as a matter of convenience only and the values

were based upon measurements of only a relatively few samples. The values above 0 °C were derived from measurements of the thermoelectric voltage on nine samples of copper versus platinum, Pt–27, between 0 and 1000 °C and on twenty-seven samples of constantan versus platinum between 0 and 800 °C. The samples were furnished by the various pyrometer instrument manufacturers at that time. Several years later, more representative tabular values were established by Scott [1940] for the subzero temperature range. The tabular values of Roeser and Dahl [1938] above 0 °C were combined with those of Scott [1940] and also corrected for changes in the temperature scales and electrical units by Shenker et al. [1951 and 1955]. The last revision of the tables in 1955 was presented in NBS Circular 561.

Extensive research on the subzero properties of Type T thermocouples was performed by members of the Cryogenic Division in Boulder. That research was summarized and tabulated by Sparks et al. [1972] in NBS Monograph 124. They indicate that Type T thermocouples may be used down to liquid hydrogen temperatures (about 20 K), but of the standardized letter-designated type thermocouples they emphasize that Type E thermocouples possess the most desirable characteristics in this range. The thermoelectric homogeneity of most Type TP and TN (or EN) thermoelements is reasonably good. However, the Seebeck coefficient of Type T thermocouples is moderately small at subzero temperatures (about 5.6 $\mu\text{V/K}$ at 20 K), being roughly two-thirds that of Type E thermocouples. This, together with the high thermal conductivity of Type TP thermoelements, is the major reason why Type T thermocouples are less suitable for use in the subzero range than Type E thermocouples. In addition, there is considerable variability in the thermoelectric properties of Type TP thermoelements at temperatures below about 76 K caused by variations in the amounts and types of impurities present in these nearly pure materials. For these reasons, Type T thermocouples are generally unsuitable for use below about 20 K.

Type T thermocouples are recommended by the ASTM [1970] for use in the temperature range from −184 to 371 °C in vacuum or in oxidizing, reducing or inert atmospheres. The recommended upper temperature limit for continuous service of protected Type T thermocouples is set at 371 °C for AWG 14 (1.6 mm) thermoelements since Type TP thermoelements oxidize rapidly above this temperature. However, the thermoelectric properties of Type TP thermoelements are apparently not grossly affected by oxidation since Roeser and Dahl [1938] observed negligible changes in the thermoelectric voltage of Nos. 12, 18 and 22 AWG Type TP thermoelements after heating for 30 hours in air at 500 °C. At this temperature the Type TN thermoelements have good resistance to oxidation and exhibit only small changes in thermal emf with long exposure in air, as shown by the studies of Dahl [1941]. Higher operating tem-

¹ Trademark—Driver Harris Company.

² Trademark—Wilbur B. Driver Company.

peratures, up to at least 700 °C, are possible in vacuum or in inert atmospheres, where the deterioration of the Type TP thermoelement is no longer a problem. Operation of Type T thermocouples in hydrogen atmospheres at temperatures above about 370 °C is not recommended since severe embrittlement of the Type TP thermoelements may occur.

Type T thermocouples are not well suited for use in nuclear environments since both thermoelements are subject to significant changes in composition under thermal neutron irradiation. The copper in the thermoelements is converted to nickel and zinc.

Because of the high thermal conductivity of Type TP thermoelements, special care should be exercised in the use of the thermocouples to insure that both the measuring and reference junctions assume the desired temperatures. Caldwell [1965] has determined the errors that arise from insufficient immersion of Type TP thermoelements in ice baths and his work should be consulted for details.

ASTM Standard E230-72 in the Annual Book of ASTM Standards [1972] specifies that the standard limits of error for Type T commercial thermocouples be ± 2 percent between -101 and -59 °C, ± 0.8 °C between -59 and 93 °C and $\pm \frac{3}{4}$ percent between 93 and 371 °C. Type T thermocouples can also be supplied to meet special limits of error, which are equal to one half the standard limits of error given above (plus a limit of error of ± 1 percent is specified between -184 and -59 °C). The recommended upper temperature limit for protected Type T thermocouples, 371 °C, applies to AWG 14 (1.6 mm) wire. For smaller wires it decreases to 260 °C for AWG 20 (0.8 mm) and 240 °C for AWG 24 or 28 (0.5 or 0.3 mm).

8.2 Data Analyses and Comparisons

The fitting functions for Type T thermocouples are based on two sets of data: below 0 °C, the research and equations of Sparks et al. [1972] were used directly; above 0 °C, values from NBS Circular 561 [1955] were used after being adjusted to the IPTS-68. Unfortunately there were no data for both high- and low-temperature calibrations on the same spool or lot of present-day material. This deficiency leads to difficulties in joining high- and low-temperature calibration curves near 0 °C.

Sparks et al. [1972] based their recommended low temperature values for the positive thermoelement, TP, on a selected wire that was most representative of two calibrated wires selected from four spools made by two different manufacturers. Material from all spools was certified by their manufacturers to be within the special limits of error (as listed in the last section) at high temperatures. Similarly, the negative thermoelement, TN, represented the best wire from three calibrated wires taken from ten spools supplied by four different manufacturers. The wires for both positive and negative thermoelements were selected after completion of careful spot calibration and inhomogeneity tests as described in Monograph 124. Values for the single thermoelements are given versus the platinum reference standard, Pt-67. Thermoelectric values for

both thermoelements and the combination were relatively difficult to fit precisely. Values for the positive thermoelement required a 14th degree power series to fit 68 points between about -270 and 0 °C with an imprecision of 0.12 μ V; the negative thermoelement required a 13th degree power series to give 0.12 μ V; and the combination (fit independently), 14th degree for an imprecision of 0.06 μ V. In Monograph 124 the two thermoelements and the total combination were fit independently; for this Monograph, equations for the total combination were used directly but the negative and positive thermoelement values were obtained by subtraction, symbolically, $TN (\equiv EN) = E - EP (\equiv KP)$ and $TP = T - TN$. Therefore, the equations for TP and TN given in this Monograph will differ very slightly from the °C transformation of the ones given in Monograph 124. The difference in calculated values will usually be less than the imprecision of the fits, 0.12 μ V.

The data on Type T thermocouples are much more sparse above 0 °C than they are below. In particular there were no data on current Type TP material. Data points for Type T were selected from NBS Circular 561, adjusted to the present temperature scale, IPTS-68, and fit with a constrained power series. The power series was constrained to have the same values for the thermoelectric voltage and Seebeck coefficient at 0 °C as those obtained from the low temperature equations. An eighth degree equation (with constrained constant and linear term) fit 17 selected key data points between 0 and 400 °C with an imprecision of 0.7 μ V. Note that this is not much worse than the low temperature fit. The second derivative was not constrained at the join.

The values for thermoelectric voltages of Type T thermocouples given in this Monograph were compared to those given by Shenker et al. [1955] in NBS Circular 561, to those given by Sparks et al. [1972], and to four representative calibrations from the Temperature Section of the National Bureau of Standards, Gaithersburg. The deviations are shown in figure 8.2.1. The values from NBS Circular 561 were adjusted to the IPTS-68. Above 0 °C the deviations between the values in this Monograph and those in NBS Circular 561 are caused primarily by the differences in fitting techniques. Below 0 °C, the deviations are caused primarily by chemical composition changes in the thermoelements. Present-day materials are slightly different in some of the minor additives.

Similar comparison graphs for the Type TP and TN thermoelements are given in figures 8.2.2. and 8.2.3. However, for Type TP thermoelements versus Pt-67, comparisons could only be made to values from the lower temperature tables [Sparks et al. 1972] and to values from the widely distributed, but unpublished, industrial tables prepared by Burns [1967].

Deviations between values given in this Monograph and those given in NBS Circular 561 are also shown in figure 8.2.4. The earlier values were adjusted to the IPTS-68. The width of the curve indicates the round-off uncertainty (1 μ V) in the tabular values given in NBS Circular 561.

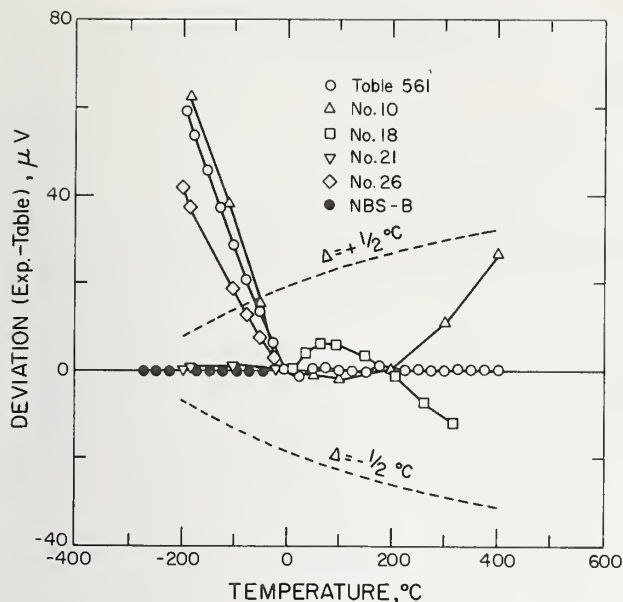


FIGURE 8.2.1. Deviations of the thermoelectric voltage of Type T thermocouples—comparison of values given in this Monograph to those given by: Table 561, NBS Circular 561; NBS-B, Sparks, et al. [1972]; Nos. 10, 18, 21 and 26, selected calibrations from the Temperature Section (NBS, Gaithersburg).

Values from previous publications and tests are adjusted to the IPTS-68. The dashed lines indicate a deviation of $\frac{1}{2}^{\circ}\text{C}$.

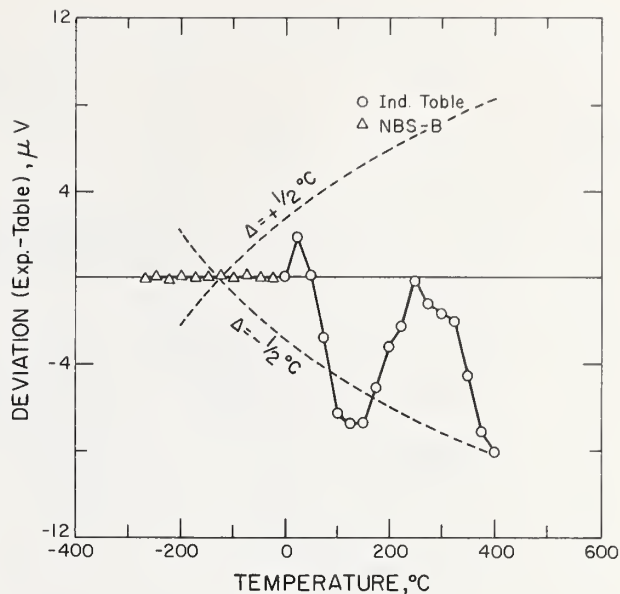


FIGURE 8.2.2. Deviations in the thermoelectric voltage of Type TP thermoelements versus platinum, Pt-67—comparison of the values given in this Monograph to those given by: Ind. Table, unpublished NBS data by Burns [1967]; NBS-B, Sparks, et al. [1972].

Values from previous publications are adjusted to the IPTS-68. The dashed lines indicate a deviation of $\frac{1}{2}^{\circ}\text{C}$.

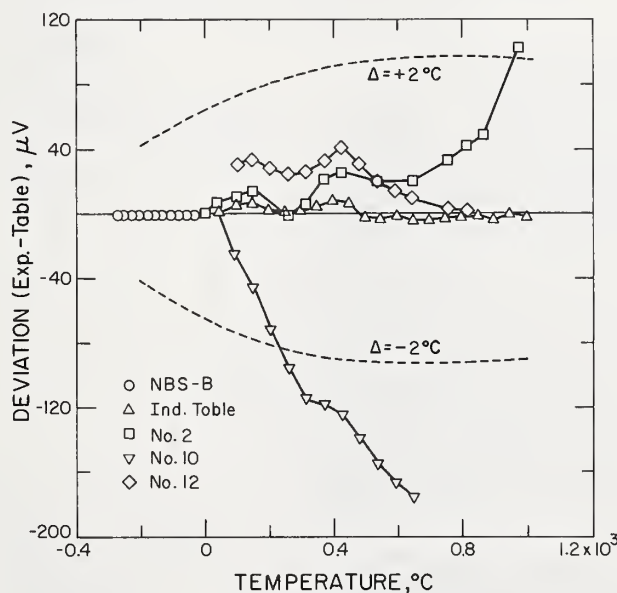


FIGURE 8.2.3. Deviations in the thermoelectric voltages of platinum, Pt-67, versus Type TN (or EN) thermoelements—comparison of values given in this Monograph to those given by: Ind. Table, unpublished NBS data by Burns [1967]; NBS-B, Sparks, et al. [1972]; Nos. 2, 10, and 12, selected calibrations from the Temperature Section (NBS, Gaithersburg).

Values from previous publications and tests are adjusted to the IPTS-68. The dashed lines indicate a deviation of 2°C .

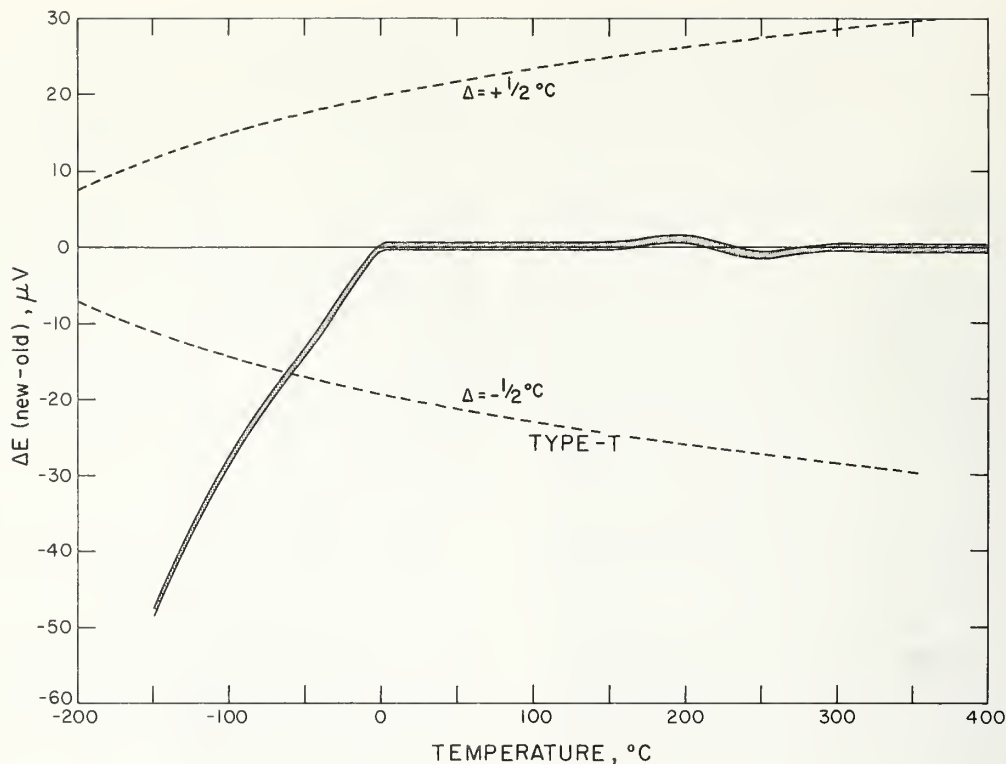


FIGURE 8.2.4. *Difference in the thermoelectric voltages for Type T thermocouples—comparison of values given in this Monograph to those given in NBS Circular 561.*
The width of the shaded curve indicates the round-off uncertainty in the previous tabular values. Values from the previous standard are adjusted to the IPTS-68. The dashed lines indicate a deviation of $\frac{1}{2}$ °C.

8.3. Reference Functions and Tables for Type T Thermocouples

The coefficients for the fourteenth degree expansion for the thermoelectric voltage of Type T thermocouples below 0 °C are given in table 8.3.1. The coefficients for the eighth degree expansion above 0 °C are also given in table 8.3.1. The errors caused by reduced bit arithmetic for calculating values of the functions are given in table 8.3.4.

The primary reference values for Type T thermocouples are given in table 8.3.2. Values at selected fixed points are given in table 8.3.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 8.3.1, 8.3.2, and 8.3.3, respectively. The irregular dip in the second derivative near 0 °C is a result of the fitting techniques at the join of two regions, it is not a real physical phenomenon.

It should be stressed that **Type T thermocouple materials that conform closely to the high temperature tabular values may not necessarily conform closely at low temperatures (below 0 °C) and vice versa.** If type T thermocouples are to be used for accurate measurements both above and below 0 °C, then the material must be calibrated in the full temperature range, both above and below 0 °C. Special selection of material will usually be required.

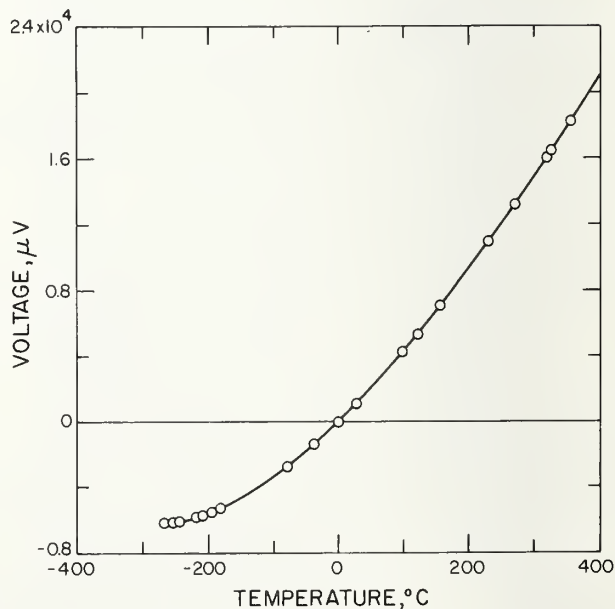


FIGURE 8.3.1. *Thermoelectric voltage for Type T thermocouples.*
The circles indicate values at various thermometric fixed points on the IPTS-68.

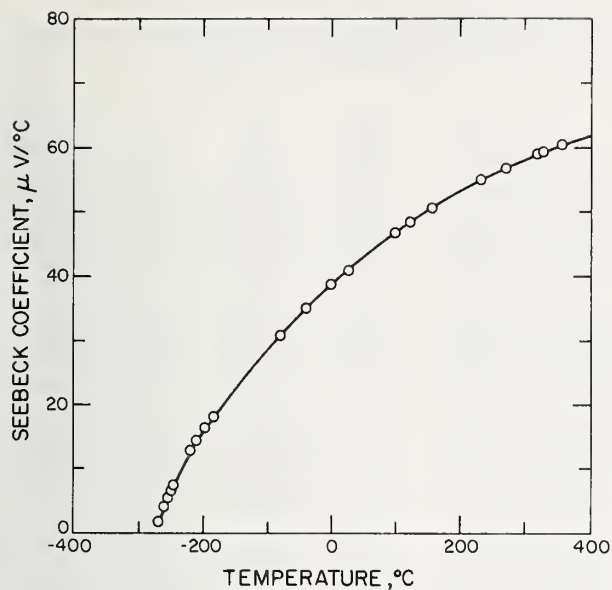


FIGURE 8.3.2. Seebeck coefficient for Type T thermocouples.
The circles indicate values at various thermometric fixed points on the IPTS-68.

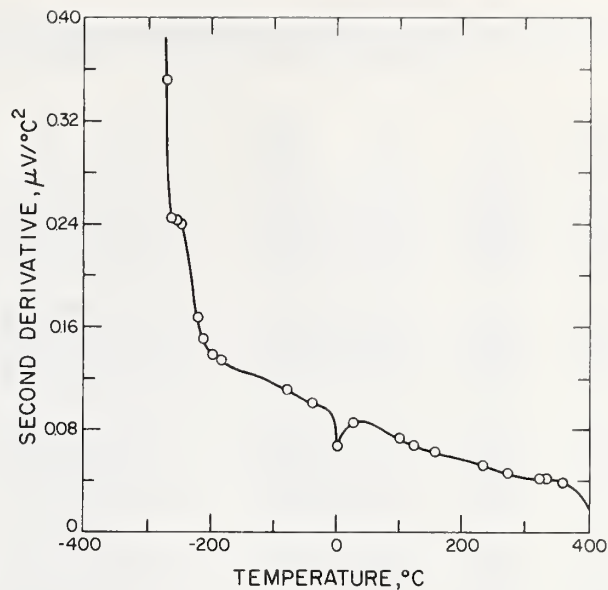


FIGURE 8.3.3. Second derivative of thermoelectric voltage for Type T thermocouples.
The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 8.3.1. Power series expansion for the thermoelectric voltage of Type T thermocouples

Temperature range	Degree	Coefficients	Term
-270 to 0 °C	14	3.8740773840×10^1	T
		$4.4123932482 \times 10^{-2}$	T^2
		$1.1405238498 \times 10^{-4}$	T^3
		$1.9974406568 \times 10^{-6}$	T^4
		$9.0445401187 \times 10^{-7}$	T^5
		$2.2766018504 \times 10^{-8}$	T^6
		$3.6247409380 \times 10^{-10}$	T^7
		$3.8648924201 \times 10^{-12}$	T^8
		$2.8298678519 \times 10^{-14}$	T^9
		$1.4281383349 \times 10^{-16}$	T^{10}
		$4.8833254364 \times 10^{-19}$	T^{11}
		$1.0803474683 \times 10^{-21}$	T^{12}
		$1.3949291026 \times 10^{-24}$	T^{13}
		$7.9795893156 \times 10^{-28}$	T^{14}
0 to 400 °C	8	3.8740773840×10^1	T
		$3.3190198092 \times 10^{-2}$	T^2
		$2.0714183645 \times 10^{-4}$	T^3
		$-2.1945834823 \times 10^{-6}$	T^4
		$1.1031900550 \times 10^{-8}$	T^5
		$-3.0927581898 \times 10^{-11}$	T^6
		$4.5653337165 \times 10^{-14}$	T^7
		$-2.7616878040 \times 10^{-17}$	T^8

TABLE 8.3.2 *Type T thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-270	-6257.59	1.016	384.94	-240	-6105.09	8.726	230.04	-210	-5753.25	14.305	149.59
-269	-6256.38	1.385	354.18	-239	-6096.25	8.954	227.51	-209	-5738.87	14.454	148.23
-268	-6254.82	1.726	328.78	-238	-6087.18	9.180	224.81	-208	-5724.34	14.602	146.96
-267	-6252.93	2.044	308.01	-237	-6077.89	9.404	221.96	-207	-5709.67	14.748	145.79
-266	-6250.74	2.343	291.24	-236	-6068.38	9.624	218.98	-206	-5694.85	14.893	144.70
-265	-6248.26	2.628	277.85	-235	-6058.64	9.842	215.90	-205	-5679.88	15.038	143.71
-264	-6245.49	2.900	267.34	-234	-6048.69	10.056	212.73	-204	-5664.77	15.181	142.79
-263	-6242.45	3.163	259.25	-233	-6038.53	10.267	209.49	-203	-5649.52	15.323	141.95
-262	-6239.17	3.419	253.16	-232	-6028.16	10.475	206.21	-202	-5634.13	15.465	141.18
-261	-6235.62	3.670	248.73	-231	-6017.58	10.680	202.91	-201	-5618.59	15.605	140.47
-260	-6231.83	3.917	245.63	-230	-6006.80	10.881	199.61	-200	-5602.92	15.746	139.82
-259	-6227.79	4.162	243.58	-229	-5995.82	11.079	196.31	-199	-5587.10	15.885	139.23
-258	-6223.51	4.405	242.34	-228	-5984.64	11.274	193.05	-198	-5571.15	16.024	138.68
-257	-6218.98	4.646	241.72	-227	-5973.27	11.465	189.83	-197	-5555.05	16.163	138.18
-256	-6214.21	4.888	241.53	-226	-5961.71	11.653	186.66	-196	-5538.82	16.301	137.72
-255	-6209.20	5.130	241.63	-225	-5949.97	11.838	183.56	-195	-5522.45	16.438	137.29
-254	-6203.95	5.371	241.90	-224	-5938.04	12.020	180.54	-194	-5505.95	16.575	136.90
-253	-6198.46	5.614	242.21	-223	-5925.93	12.199	177.62	-193	-5489.30	16.712	136.53
-252	-6192.72	5.856	242.49	-222	-5913.64	12.376	174.78	-192	-5472.52	16.848	136.18
-251	-6186.75	6.098	242.68	-221	-5901.18	12.549	172.05	-191	-5455.61	16.984	135.85
-250	-6180.53	6.341	242.71	-220	-5888.54	12.720	169.43	-190	-5438.55	17.120	135.54
-249	-6174.07	6.584	242.54	-219	-5875.74	12.888	166.92	-189	-5421.37	17.255	135.25
-248	-6167.36	6.826	242.16	-218	-5862.77	13.054	164.53	-188	-5404.04	17.390	134.96
-247	-6160.41	7.068	241.52	-217	-5849.63	13.217	162.25	-187	-5386.59	17.525	134.68
-246	-6153.22	7.309	240.63	-216	-5836.33	13.378	160.09	-186	-5368.99	17.660	134.41
-245	-6145.80	7.549	239.48	-215	-5822.88	13.537	158.06	-185	-5351.27	17.794	134.14
-244	-6138.13	7.788	238.08	-214	-5809.26	13.694	156.14	-184	-5333.40	17.928	133.88
-243	-6130.22	8.025	236.41	-213	-5795.49	13.850	154.33	-183	-5315.41	18.062	133.61
-242	-6122.08	8.261	234.52	-212	-5781.56	14.003	152.64	-182	-5297.28	18.195	133.35
-241	-6113.70	8.494	232.38	-211	-5767.48	14.155	151.06	-181	-5279.02	18.328	133.09
-240	-6105.09	8.726	230.04	-210	-5753.25	14.305	149.59	-180	-5260.62	18.461	132.82

TABLE 8.3.2 *Type T thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-180	-5260.62	18.461	132.82	-120	-3922.62	26.026	120.94	-60	-2152.41	32.840	106.55
-179	-5242.10	18.594	132.55	-119	-3896.54	26.147	120.72	-59	-2119.52	32.946	106.25
-178	-5223.44	18.727	132.29	-118	-3870.33	26.268	120.49	-58	-2086.52	33.052	105.94
-177	-5204.64	18.859	132.01	-117	-3844.00	26.388	120.26	-57	-2053.42	33.158	105.63
-176	-5185.72	18.991	131.74	-116	-3817.56	26.508	120.02	-56	-2020.21	33.264	105.31
-175	-5166.66	19.122	131.47	-115	-3790.99	26.628	119.77	-55	-1986.89	33.369	104.98
-174	-5147.47	19.254	131.19	-114	-3764.30	26.748	119.52	-54	-1953.47	33.474	104.66
-173	-5128.16	19.385	130.91	-113	-3737.49	26.867	119.26	-53	-1919.94	33.578	104.32
-172	-5108.71	19.515	130.63	-112	-3710.57	26.986	119.00	-52	-1886.31	33.682	103.99
-171	-5089.12	19.646	130.35	-111	-3683.52	27.105	118.73	-51	-1852.58	33.786	103.66
-170	-5069.41	19.776	130.07	-110	-3656.36	27.224	118.46	-50	-1818.74	33.889	103.33
-169	-5049.57	19.906	129.79	-109	-3629.07	27.342	118.19	-49	-1784.80	33.993	103.00
-168	-5029.60	20.036	129.51	-108	-3601.67	27.460	117.91	-48	-1750.75	34.095	102.68
-167	-5009.50	20.165	129.24	-107	-3574.15	27.578	117.64	-47	-1716.61	34.198	102.36
-166	-4989.27	20.294	128.96	-106	-3546.52	27.695	117.36	-46	-1682.36	34.300	102.05
-165	-4968.91	20.423	128.70	-105	-3518.76	27.812	117.08	-45	-1648.01	34.402	101.75
-164	-4948.43	20.551	128.43	-104	-3490.89	27.929	116.80	-44	-1613.55	34.504	101.46
-163	-4927.81	20.680	128.17	-103	-3462.90	28.046	116.52	-43	-1579.00	34.605	101.18
-162	-4907.07	20.808	127.91	-102	-3434.80	28.162	116.24	-42	-1544.34	34.706	100.92
-161	-4886.20	20.936	127.67	-101	-3406.58	28.278	115.96	-41	-1509.59	34.807	100.67
-160	-4865.20	21.063	127.42	-100	-3378.24	28.394	115.69	-40	-1474.73	34.907	100.43
-159	-4844.07	21.190	127.19	-99	-3349.79	28.510	115.42	-39	-1439.77	35.008	100.22
-158	-4822.81	21.318	126.96	-98	-3321.22	28.625	115.15	-38	-1404.72	35.108	100.01
-157	-4801.43	21.444	126.74	-97	-3292.54	28.740	114.88	-37	-1369.56	35.208	99.83
-156	-4779.93	21.571	126.52	-96	-3263.74	28.855	114.62	-36	-1334.30	35.308	99.66
-155	-4758.29	21.697	126.31	-95	-3234.83	28.969	114.37	-35	-1298.94	35.407	99.52
-154	-4736.53	21.824	126.12	-94	-3205.80	29.084	114.12	-34	-1263.49	35.507	99.38
-153	-4714.64	21.950	125.92	-93	-3176.66	29.198	113.87	-33	-1227.93	35.606	99.26
-152	-4692.63	22.075	125.74	-92	-3147.44	29.311	113.63	-32	-1192.27	35.705	99.16
-151	-4670.49	22.201	125.57	-91	-3118.04	29.425	113.40	-31	-1156.52	35.804	99.07
-150	-4648.23	22.327	125.40	-90	-3088.56	29.538	113.17	-30	-1120.67	35.903	98.99
-149	-4625.84	22.452	125.23	-89	-3058.96	29.651	112.95	-29	-1084.71	36.002	98.91
-148	-4603.33	22.577	125.08	-88	-3029.26	29.764	112.73	-28	-1048.66	36.101	98.84
-147	-4580.69	22.702	124.93	-87	-2999.44	29.877	112.51	-27	-1012.51	36.200	98.76
-146	-4557.92	22.827	124.79	-86	-2969.50	29.989	112.30	-26	-976.26	36.299	98.69
-145	-4535.03	22.952	124.65	-85	-2939.46	30.101	112.10	-25	-939.91	36.397	98.60
-144	-4512.02	23.076	124.51	-84	-2909.30	30.213	111.89	-24	-903.47	36.496	98.50
-143	-4488.88	23.201	124.38	-83	-2879.03	30.325	111.70	-23	-866.92	36.594	98.37
-142	-4465.62	23.325	124.26	-82	-2848.65	30.437	111.50	-22	-830.28	36.693	98.23
-141	-4442.23	23.449	124.13	-81	-2818.16	30.548	111.31	-21	-793.54	36.791	98.05
-140	-4418.72	23.573	124.01	-80	-2787.55	30.659	111.11	-20	-756.70	36.889	97.83
-139	-4395.08	23.697	123.89	-79	-2756.84	30.770	110.92	-19	-719.76	36.986	97.58
-138	-4371.32	23.821	123.77	-78	-2726.01	30.881	110.73	-18	-682.73	37.084	97.27
-137	-4347.44	23.945	123.65	-77	-2695.08	30.992	110.54	-17	-645.59	37.181	96.91
-136	-4323.43	24.068	123.52	-76	-2664.03	31.102	110.35	-16	-608.36	37.278	96.50
-135	-4299.30	24.192	123.40	-75	-2632.87	31.213	110.15	-15	-571.04	37.374	96.03
-134	-4275.05	24.315	123.27	-74	-2601.61	31.323	109.96	-14	-533.62	37.470	95.49
-133	-4250.67	24.438	123.14	-73	-2570.23	31.432	109.76	-13	-496.10	37.565	94.90
-132	-4226.17	24.561	123.01	-72	-2538.74	31.542	109.55	-12	-458.49	37.659	94.25
-131	-4201.55	24.684	122.87	-71	-2507.14	31.652	109.34	-11	-420.78	37.753	93.54
-130	-4176.81	24.807	122.73	-70	-2475.44	31.761	109.12	-10	-382.98	37.846	92.79
-129	-4151.94	24.930	122.58	-69	-2443.62	31.870	108.90	-9	-345.09	37.939	92.01
-128	-4126.95	25.052	122.42	-68	-2411.70	31.979	108.67	-8	-307.10	38.030	91.20
-127	-4101.83	25.175	122.26	-67	-2379.67	32.087	108.43	-7	-269.03	38.121	90.41
-126	-4076.60	25.297	122.09	-66	-2347.52	32.195	108.19	-6	-230.86	38.211	89.64
-125	-4051.24	25.419	121.92	-65	-2315.27	32.303	107.94	-5	-192.61	38.301	88.94
-124	-4025.76	25.541	121.74	-64	-2282.92	32.411	107.68	-4	-154.26	38.389	88.35
-123	-4000.16	25.662	121.55	-63	-2250.45	32.519	107.41	-3	-115.83	38.477	87.92
-122	-3974.43	25.784	121.35	-62	-2217.88	32.626	107.13	-2	-77.31	38.565	87.70
-121	-3948.59	25.905	121.15	-61	-2185.20	32.733	106.85	-1	-38.70	38.653	87.79
-120	-3922.62	26.026	120.94	-60	-2152.41	32.840	106.55	0	0.00	38.741	66.38

TABLE 8.3.2 *Type T thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.0	38.741	66.38	60	2467.5	43.649	83.20	120	5227.0	48.181	68.26
1	38.8	38.808	67.60	61	2511.2	43.733	82.98	121	5275.3	48.250	68.06
2	77.6	38.876	68.76	62	2555.0	43.815	82.75	122	5323.5	48.318	67.86
3	116.5	38.945	69.88	63	2598.8	43.898	82.52	123	5371.9	48.385	67.67
4	155.5	39.016	70.94	64	2642.8	43.980	82.28	124	5420.3	48.453	67.47
5	194.6	39.087	71.96	65	2686.8	44.063	82.04	125	5468.8	48.520	67.28
6	233.7	39.160	72.94	66	2730.9	44.145	81.79	126	5517.3	48.587	67.09
7	272.9	39.233	73.86	67	2775.1	44.226	81.55	127	5566.0	48.654	66.91
8	312.1	39.307	74.75	68	2819.3	44.308	81.29	128	5614.7	48.721	66.72
9	351.5	39.382	75.59	69	2863.7	44.389	81.04	129	5663.4	48.788	66.54
10	390.9	39.458	76.39	70	2908.1	44.470	80.78	130	5712.2	48.854	66.36
11	430.4	39.535	77.15	71	2952.6	44.550	80.52	131	5761.1	48.921	66.19
12	470.0	39.613	77.86	72	2997.2	44.631	80.26	132	5810.1	48.987	66.01
13	509.6	39.691	78.55	73	3041.9	44.711	79.99	133	5859.1	49.053	65.84
14	549.4	39.770	79.19	74	3086.6	44.791	79.73	134	5908.2	49.118	65.67
15	589.2	39.849	79.80	75	3131.5	44.870	79.46	135	5957.3	49.184	65.50
16	629.1	39.929	80.37	76	3176.4	44.950	79.19	136	6006.5	49.249	65.33
17	669.0	40.010	80.91	77	3221.4	45.029	78.92	137	6055.8	49.315	65.17
18	709.1	40.091	81.41	78	3266.4	45.107	78.65	138	6105.2	49.380	65.01
19	749.2	40.173	81.88	79	3311.6	45.186	78.38	139	6154.6	49.445	64.85
20	789.4	40.255	82.33	80	3356.8	45.264	78.10	140	6204.1	49.509	64.69
21	829.7	40.338	82.74	81	3402.1	45.342	77.83	141	6253.6	49.574	64.53
22	870.1	40.420	83.12	82	3447.5	45.420	77.56	142	6303.2	49.639	64.38
23	910.6	40.504	83.47	83	3492.9	45.497	77.29	143	6352.9	49.703	64.23
24	951.1	40.587	83.80	84	3538.5	45.574	77.01	144	6402.6	49.767	64.07
25	991.7	40.671	84.10	85	3584.1	45.651	76.74	145	6452.4	49.831	63.93
26	1032.5	40.756	84.37	86	3629.8	45.728	76.47	146	6502.3	49.895	63.78
27	1073.3	40.840	84.62	87	3675.5	45.804	76.20	147	6552.2	49.959	63.63
28	1114.1	40.925	84.84	88	3721.4	45.880	75.93	148	6602.2	50.022	63.49
29	1155.1	41.010	85.04	89	3767.3	45.956	75.66	149	6652.2	50.086	63.34
30	1196.2	41.095	85.22	90	3813.3	46.032	75.39	150	6702.4	50.149	63.20
31	1237.3	41.180	85.37	91	3859.4	46.107	75.13	151	6752.5	50.212	63.06
32	1278.5	41.266	85.50	92	3905.5	46.182	74.86	152	6802.8	50.275	62.92
33	1319.8	41.351	85.62	93	3951.7	46.257	74.60	153	6853.1	50.338	62.78
34	1361.2	41.437	85.71	94	3998.0	46.331	74.34	154	6903.5	50.400	62.65
35	1402.7	41.523	85.79	95	4044.4	46.405	74.08	155	6953.9	50.463	62.51
36	1444.3	41.608	85.84	96	4090.8	46.479	73.82	156	7004.4	50.526	62.37
37	1485.9	41.694	85.88	97	4137.4	46.553	73.56	157	7054.9	50.588	62.24
38	1527.7	41.780	85.90	98	4183.9	46.626	73.30	158	7105.6	50.650	62.11
39	1569.5	41.866	85.91	99	4230.6	46.700	73.05	159	7156.2	50.712	61.98
40	1611.4	41.952	85.89	100	4277.3	46.773	72.80	160	7207.0	50.774	61.84
41	1653.4	42.038	85.87	101	4324.2	46.845	72.55	161	7257.8	50.836	61.71
42	1695.5	42.124	85.83	102	4371.0	46.918	72.30	162	7308.7	50.897	61.58
43	1737.6	42.209	85.77	103	4418.0	46.990	72.06	163	7359.6	50.959	61.46
44	1779.9	42.295	85.70	104	4465.0	47.062	71.81	164	7410.6	51.020	61.33
45	1822.2	42.381	85.62	105	4512.1	47.133	71.57	165	7461.6	51.082	61.20
46	1864.6	42.466	85.53	106	4559.3	47.205	71.34	166	7512.7	51.143	61.07
47	1907.1	42.552	85.42	107	4606.5	47.276	71.10	167	7563.9	51.204	60.94
48	1949.7	42.637	85.31	108	4653.8	47.347	70.87	168	7615.2	51.265	60.82
49	1992.4	42.723	85.18	109	4701.2	47.418	70.64	169	7666.4	51.325	60.69
50	2035.2	42.808	85.04	110	4748.7	47.488	70.41	170	7717.8	51.386	60.57
51	2078.0	42.893	84.89	111	4796.2	47.559	70.18	171	7769.2	51.446	60.44
52	2121.0	42.977	84.74	112	4843.8	47.629	69.96	172	7820.7	51.507	60.32
53	2164.0	43.062	84.57	113	4891.4	47.699	69.74	173	7872.2	51.567	60.19
54	2207.1	43.147	84.40	114	4939.2	47.768	69.52	174	7923.8	51.627	60.07
55	2250.3	43.231	84.21	115	4987.0	47.838	69.30	175	7975.5	51.687	59.94
56	2293.6	43.315	84.02	116	5034.9	47.907	69.09	176	8027.2	51.747	59.82
57	2336.9	43.399	83.83	117	5082.8	47.976	68.88	177	8079.0	51.807	59.69
58	2380.4	43.483	83.62	118	5130.8	48.045	68.67	178	8130.8	51.866	59.57
59	2423.9	43.566	83.41	119	5178.9	48.113	68.46	179	8182.7	51.926	59.44
60	2467.5	43.649	83.20	120	5227.0	48.181	68.26	180	8234.7	51.985	59.32

TABLE 8.3.2 *Type T thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	8234.7	51.985	59.32	240	11455.8	55.300	50.80	300	14859.8	58.086	42.86
181	8286.7	52.045	59.19	241	11511.1	55.351	50.64	301	14917.9	58.129	42.78
182	8338.8	52.104	59.07	242	11566.5	55.401	50.48	302	14976.1	58.172	42.69
183	8390.9	52.163	58.94	243	11621.9	55.452	50.32	303	15034.3	58.215	42.62
184	8443.1	52.222	58.81	244	11677.4	55.502	50.17	304	15092.5	58.257	42.54
185	8495.3	52.280	58.69	245	11732.9	55.552	50.01	305	15150.8	58.300	42.46
186	8547.6	52.339	58.56	246	11788.5	55.602	49.85	306	15209.1	58.342	42.39
187	8600.0	52.397	58.43	247	11844.1	55.652	49.69	307	15267.5	58.385	42.32
188	8652.4	52.456	58.31	248	11899.8	55.701	49.54	308	15325.9	58.427	42.25
189	8704.9	52.514	58.18	249	11955.5	55.751	49.38	309	15384.3	58.469	42.19
190	8757.5	52.572	58.05	250	12011.3	55.800	49.22	310	15442.8	58.511	42.12
191	8810.1	52.630	57.92	251	12067.1	55.849	49.07	311	15501.3	58.553	42.06
192	8862.7	52.688	57.79	252	12123.0	55.898	48.91	312	15559.9	58.595	41.99
193	8915.4	52.746	57.66	253	12178.9	55.947	48.76	313	15618.5	58.637	41.93
194	8968.2	52.803	57.53	254	12234.9	55.996	48.60	314	15677.2	58.679	41.88
195	9021.1	52.861	57.40	255	12290.9	56.044	48.45	315	15735.9	58.721	41.82
196	9073.9	52.918	57.27	256	12347.0	56.093	48.30	316	15794.6	58.763	41.76
197	9126.9	52.975	57.13	257	12403.1	56.141	48.14	317	15853.4	58.805	41.71
198	9179.9	53.032	57.00	258	12459.3	56.189	47.99	318	15912.2	58.846	41.65
199	9233.0	53.089	56.87	259	12515.5	56.237	47.84	319	15971.1	58.888	41.60
200	9286.1	53.146	56.73	260	12571.7	56.285	47.69	320	16030.0	58.929	41.55
201	9339.2	53.203	56.60	261	12628.0	56.332	47.54	321	16089.0	58.971	41.50
202	9392.5	53.259	56.46	262	12684.4	56.380	47.39	322	16148.0	59.012	41.45
203	9445.8	53.316	56.32	263	12740.8	56.427	47.25	323	16207.0	59.054	41.40
204	9499.1	53.372	56.19	264	12797.3	56.474	47.10	324	16266.1	59.095	41.35
205	9552.5	53.428	56.05	265	12853.8	56.521	46.95	325	16325.2	59.137	41.31
206	9606.0	53.484	55.91	266	12910.3	56.568	46.81	326	16384.3	59.178	41.26
207	9659.5	53.540	55.77	267	12966.9	56.615	46.67	327	16443.5	59.219	41.21
208	9713.0	53.596	55.63	268	13023.5	56.661	46.52	328	16502.8	59.260	41.17
209	9766.7	53.651	55.49	269	13080.2	56.708	46.38	329	16562.1	59.301	41.12
210	9820.3	53.707	55.35	270	13136.9	56.754	46.24	330	16621.4	59.343	41.07
211	9874.1	53.762	55.20	271	13193.7	56.800	46.11	331	16680.7	59.384	41.02
212	9927.9	53.817	55.06	272	13250.5	56.846	45.97	332	16740.1	59.425	40.98
213	9981.7	53.872	54.92	273	13307.4	56.892	45.84	333	16799.6	59.466	40.93
214	10035.6	53.927	54.77	274	13364.3	56.938	45.70	334	16859.1	59.506	40.88
215	10089.6	53.982	54.63	275	13421.3	56.984	45.57	335	16918.6	59.547	40.83
216	10143.6	54.036	54.48	276	13478.3	57.029	45.44	336	16978.2	59.588	40.77
217	10197.6	54.091	54.33	277	13535.3	57.075	45.31	337	17037.8	59.629	40.72
218	10251.8	54.145	54.18	278	13592.4	57.120	45.18	338	17097.4	59.670	40.67
219	10305.9	54.199	54.04	279	13649.6	57.165	45.06	339	17157.1	59.710	40.61
220	10360.2	54.253	53.89	280	13706.8	57.210	44.93	340	17216.8	59.751	40.55
221	10414.4	54.307	53.74	281	13764.0	57.255	44.81	341	17276.6	59.791	40.49
222	10468.8	54.360	53.59	282	13821.3	57.300	44.69	342	17336.4	59.832	40.42
223	10523.2	54.414	53.44	283	13878.6	57.344	44.57	343	17396.3	59.872	40.35
224	10577.6	54.467	53.28	284	13936.0	57.389	44.46	344	17456.2	59.912	40.28
225	10632.1	54.520	53.13	285	13993.4	57.433	44.34	345	17516.1	59.953	40.21
226	10686.6	54.573	52.98	286	14050.8	57.477	44.23	346	17576.1	59.993	40.13
227	10741.2	54.626	52.82	287	14108.3	57.522	44.12	347	17636.1	60.033	40.05
228	10795.9	54.679	52.67	288	14165.9	57.566	44.01	348	17696.1	60.073	39.97
229	10850.6	54.732	52.52	289	14223.5	57.610	43.90	349	17756.2	60.113	39.87
230	10905.4	54.784	52.36	290	14281.1	57.653	43.80	350	17816.4	60.153	39.78
231	10960.2	54.836	52.21	291	14338.8	57.697	43.69	351	17876.5	60.192	39.68
232	11015.0	54.889	52.05	292	14396.5	57.741	43.59	352	17936.8	60.232	39.57
233	11069.9	54.941	51.89	293	14454.3	57.784	43.49	353	17997.0	60.272	39.46
234	11124.9	54.992	51.74	294	14512.1	57.828	43.40	354	18057.3	60.311	39.34
235	11179.9	55.044	51.58	295	14569.9	57.871	43.30	355	18117.6	60.350	39.22
236	11235.0	55.096	51.42	296	14627.8	57.914	43.21	356	18178.0	60.389	39.08
237	11290.1	55.147	51.27	297	14685.7	57.958	43.12	357	18238.4	60.428	38.94
238	11345.3	55.198	51.11	298	14743.7	58.001	43.03	358	18298.9	60.467	38.80
239	11400.5	55.249	50.95	299	14801.7	58.044	42.94	359	18359.3	60.506	38.64
240	11455.8	55.300	50.80	300	14859.8	58.086	42.86	360	18419.9	60.545	38.47

TABLE 8.3.2 *Type T thermocouples—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	18419.9	60.545	38.47	375	19332.2	61.096	34.64	390	20252.3	61.564	26.88
361	18480.4	60.583	38.30	376	19393.4	61.131	34.26	391	20313.9	61.591	26.16
362	18541.0	60.621	38.12	377	19454.5	61.165	33.88	392	20375.5	61.616	25.42
363	18601.7	60.659	37.92	378	19515.7	61.199	33.47	393	20437.2	61.641	24.65
364	18662.3	60.697	37.72	379	19576.9	61.232	33.04	394	20498.8	61.666	23.84
365	18723.1	60.735	37.50	380	19638.2	61.265	32.59	395	20560.5	61.689	23.01
366	18783.8	60.772	37.28	381	19699.4	61.297	32.13	396	20622.2	61.712	22.14
367	18844.6	60.809	37.04	382	19760.7	61.329	31.64	397	20683.9	61.733	21.23
368	18905.4	60.846	36.79	383	19822.1	61.360	31.13	398	20745.7	61.754	20.29
369	18966.3	60.883	36.52	384	19883.5	61.391	30.60	399	20807.4	61.774	19.32
370	19027.2	60.919	36.25	385	19944.9	61.422	30.04	400	20869.2	61.793	18.31
371	19088.1	60.955	35.96	386	20006.3	61.451	29.46				
372	19149.1	60.991	35.65	387	20067.8	61.480	28.85				
373	19210.1	61.027	35.33	388	20129.3	61.509	28.22				
374	19271.2	61.062	34.99	389	20190.8	61.537	27.56				
375	19332.2	61.096	34.64	390	20252.3	61.564	26.88				

TABLE 8.3.3. *Thermoelectric values at the fixed points for Type T thermocouples*

Fixed point	Temp. °C	E μV	S μV/°C	dS/dT nV/°C
Helium NBP	-268.935	-6256.29	1.408	352.36
Hydrogen TP	-259.340	-6229.19	4.07	244.17
Hydrogen NBP	-252.870	-6197.73	5.645	242.25
Neon TP	-248.595	-6171.38	6.682	242.42
Neon NBP	-246.048	-6153.58	7.298	240.69
Oxygen TP	-218.789	-5873.02	12.923	166.41
Nitrogen TP	-210.002	-5753.28	14.305	149.60
Nitrogen NBP	-195.802	-5535.59	16.328	137.63
Oxygen NBP	-182.962	-5314.72	18.067	133.60
Carbon Dioxide SP	-78.476	-2740.70	30.828	110.82
Mercury FP	-38.862	-1434.94	35.022	100.19
Ice point*	0.000	0.0	38.741	66.38
Ether TP	26.870	1067.9	40.829	84.59
Water BP	100.000	4277.3	46.773	72.80
Benzoic TP	122.370	5341.4	48.343	67.79
Indium FP	156.634	7036.4	50.565	62.29
Tin FP	231.9681	11013.3	54.887	52.06
Bismuth FP	271.442	13218.8	56.821	46.05
Cadmium FP	321.108	16095.3	58.975	41.49
Lead FP	327.502	16473.3	59.240	41.19
Mercury BP	356.660	18217.9	60.415	38.99

*Junction point of different functions.

TABLE 8.3.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type T thermocouples*

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-270 to -200 °C	14	(*)	(*)	30	1	<0.01
-200 to 0 °C	14	(*)	700	3	0.3	<0.01
0 to 200 °C	8	5	0.2	<0.01	<0.01	<0.01
200 to 400 °C	8	80	6	0.03	<0.01	<0.01

*A high-order polynomial with a low-bit machine causes extreme error.

8.4. Reference Functions and Tables for the Positive Thermoelement, Type TP, Copper Versus Platinum, Pt-67

The coefficients for the fourteenth degree expansion for the thermoelectric voltage of Type TP thermoelements versus Pt-67 below 0 °C are given in table 8.4.1. The coefficients for the ninth degree expansion above 0 °C are also given in table 8.4.1. Errors caused by using reduced-bit arithmetic for calculating values of the functions are given in table 8.4.4.

The primary reference values for Type TP thermoelements versus Pt-67 are given in table 8.4.2. Values at selected fixed points are given in table 8.4.3. Graphs

of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 8.4.1, 8.4.2, and 8.4.3, respectively.

It should be stressed that **Type TP thermoelement material that conforms closely to the high temperature tabular value may not necessarily conform closely at low temperatures (below 0 °C) and vice versa.** If Type TP thermoelements are to be used for accurate measurements both above and below 0 °C, then the material must be calibrated in the full temperature range, both above and below 0 °C. Special selection of material will usually be required.

TABLE 8.4.1. Power series expansion for the thermoelectric voltage of Type TP thermoelements versus platinum, Pt-67

Temperature range	Degree	Coefficients	Term
-270 to 0 °C	14	5.8806261740 ...	T
		$1.9658561192 \times 10^{-2}$	T^2
		$1.7712284201 \times 10^{-4}$	T^3
		$2.0479611841 \times 10^{-5}$	T^4
		$9.4510605099 \times 10^{-7}$	T^5
		$2.4639527148 \times 10^{-8}$	T^6
		$4.0166759205 \times 10^{-10}$	T^7
		$4.3256251496 \times 10^{-12}$	T^8
		$3.1619504221 \times 10^{-14}$	T^9
		$1.5784862573 \times 10^{-16}$	T^{10}
		$5.3010783090 \times 10^{-19}$	T^{11}
		$1.1454963751 \times 10^{-21}$	T^{12}
		$1.4386009111 \times 10^{-24}$	T^{13}
		$7.9795893156 \times 10^{-28}$	T^{14}
0 to 400 °C	9	5.8806261740 ...	T
		$1.6201404918 \times 10^{-2}$	T^2
		$1.1636815449 \times 10^{-4}$	T^3
		$-1.6384754004 \times 10^{-6}$	T^4
		$9.4887045900 \times 10^{-9}$	T^5
		$-2.8443781735 \times 10^{-11}$	T^6
		$4.3314365019 \times 10^{-14}$	T^7
		$-2.6422248358 \times 10^{-17}$	T^8
		$-2.5561127497 \times 10^{-22}$	T^9

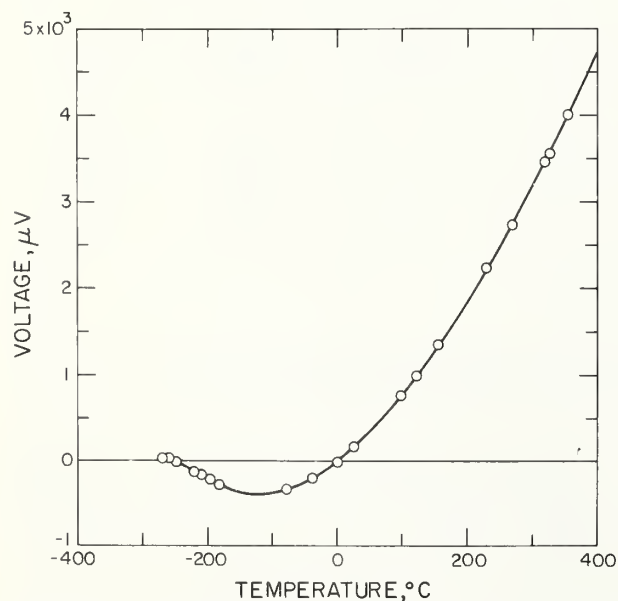


FIGURE 8.4.1. Thermoelectric voltage for Type TP thermoelements versus platinum, Pt-67.

The circles indicate values at various thermometric fixed points on the IPTS-68.

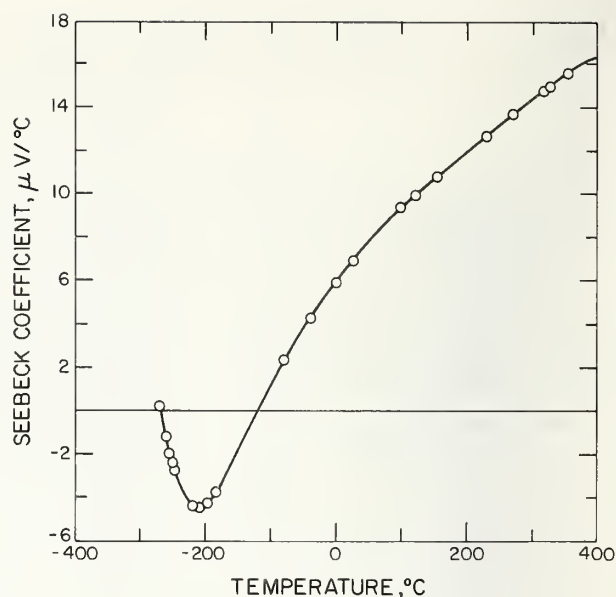


FIGURE 8.4.2. Seebeck coefficient for Type TP thermoelements versus platinum, Pt-67.

The circles indicate values at various thermometric fixed points on the IPTS-68.

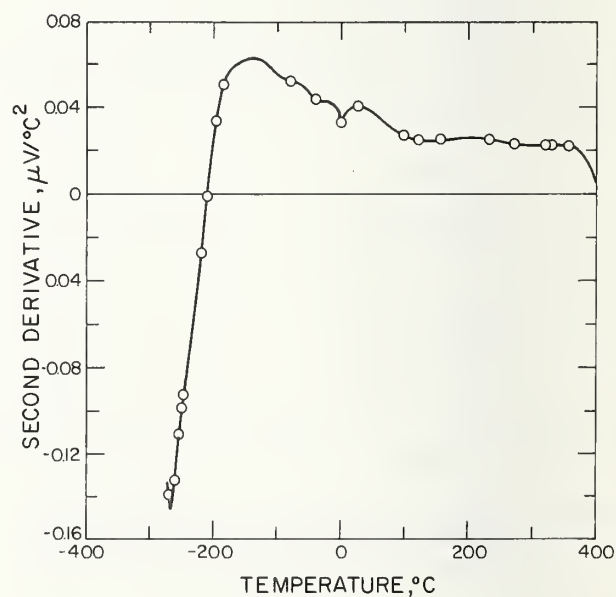


FIGURE 8.4.3. Second derivative of thermoelectric voltage for Type TP thermoelements versus platinum, Pt-67.

The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 8.4.2. *Type TP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-270	19.66	0.316	-132.66	-240	-28.87	-3.184	-80.26	-210	-150.15	-4.501	-1.42
-269	19.92	0.180	-138.50	-239	-32.09	-3.263	-78.26	-209	-154.65	-4.501	1.47
-268	20.02	0.040	-142.36	-238	-35.40	-3.341	-76.24	-208	-159.15	-4.498	4.32
-267	19.99	-0.104	-144.57	-237	-38.78	-3.416	-74.20	-207	-163.65	-4.492	7.11
-266	19.81	-0.249	-145.41	-236	-42.23	-3.489	-72.12	-206	-168.13	-4.484	9.85
-265	19.49	-0.394	-145.16	-235	-45.75	-3.560	-70.01	-205	-172.61	-4.473	12.53
-264	19.02	-0.539	-144.00	-234	-49.35	-3.629	-67.86	-204	-177.08	-4.459	15.13
-263	18.41	-0.682	-142.18	-233	-53.01	-3.696	-65.65	-203	-181.53	-4.442	17.67
-262	17.66	-0.823	-139.81	-232	-56.74	-3.760	-63.38	-202	-185.96	-4.423	20.14
-261	16.77	-0.962	-137.05	-231	-60.53	-3.823	-61.05	-201	-190.38	-4.402	22.52
-260	15.74	-1.097	-134.01	-230	-64.38	-3.882	-58.66	-200	-194.77	-4.378	24.82
-259	14.57	-1.229	-130.80	-229	-68.29	-3.940	-56.20	-199	-199.13	-4.353	27.04
-258	13.28	-1.359	-127.48	-228	-72.26	-3.995	-53.67	-198	-203.47	-4.324	29.18
-257	11.86	-1.484	-124.13	-227	-76.28	-4.047	-51.08	-197	-207.78	-4.294	31.22
-256	10.31	-1.607	-120.80	-226	-80.36	-4.097	-48.43	-196	-212.06	-4.262	33.18
-255	8.64	-1.726	-117.51	-225	-84.48	-4.144	-45.72	-195	-216.30	-4.228	35.05
-254	6.86	-1.842	-114.31	-224	-88.64	-4.188	-42.95	-194	-220.51	-4.192	36.83
-253	4.96	-1.955	-111.22	-223	-92.85	-4.230	-40.13	-193	-224.69	-4.154	38.52
-252	2.95	-2.064	-108.24	-222	-97.10	-4.269	-37.26	-192	-228.82	-4.115	40.13
-251	0.83	-2.171	-105.37	-221	-101.39	-4.304	-34.35	-191	-232.92	-4.074	41.64
-250	-1.39	-2.275	-102.64	-220	-105.71	-4.337	-31.40	-190	-236.97	-4.032	43.08
-249	-3.72	-2.377	-100.02	-219	-110.06	-4.367	-28.42	-189	-240.98	-3.988	44.42
-248	-6.14	-2.475	-97.52	-218	-114.44	-4.394	-25.42	-188	-244.94	-3.943	45.69
-247	-8.67	-2.572	-95.12	-217	-118.85	-4.418	-22.40	-187	-248.86	-3.896	46.87
-246	-11.29	-2.666	-92.82	-216	-123.28	-4.439	-19.38	-186	-252.74	-3.849	47.97
-245	-14.00	-2.757	-90.60	-215	-127.73	-4.457	-16.35	-185	-256.56	-3.801	49.00
-244	-16.80	-2.847	-88.45	-214	-132.19	-4.472	-13.32	-184	-260.34	-3.751	49.96
-243	-19.69	-2.934	-86.36	-213	-136.67	-4.483	-10.31	-183	-264.06	-3.701	50.85
-242	-22.66	-3.020	-84.30	-212	-141.16	-4.492	-7.32	-182	-267.74	-3.649	51.67
-241	-25.73	-3.103	-82.28	-211	-145.65	-4.498	-4.36	-181	-271.36	-3.597	52.43
-240	-28.87	-3.184	-80.26	-210	-150.15	-4.501	-1.42	-180	-274.93	-3.545	53.13

TABLE 8.4.2. Type TP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-180	-274.93	-3.545	53.13	-120	-381.67	0.057	60.60	-60	-278.24	3.291	49.88
-179	-278.45	-3.491	53.78	-119	-381.58	0.118	60.36	-59	-274.93	3.341	49.65
-178	-281.91	-3.437	54.37	-118	-381.44	0.178	60.11	-58	-271.56	3.390	49.40
-177	-285.32	-3.382	54.91	-117	-381.23	0.238	59.84	-57	-268.15	3.440	49.13
-176	-288.68	-3.327	55.41	-116	-380.96	0.297	59.57	-56	-264.80	3.489	48.85
-175	-291.98	-3.272	55.86	-115	-380.63	0.357	59.28	-55	-261.17	3.537	48.55
-174	-295.22	-3.216	56.27	-114	-380.25	0.416	58.99	-54	-257.61	3.586	48.24
-173	-298.41	-3.159	56.65	-113	-379.80	0.475	58.69	-53	-254.00	3.634	47.92
-172	-301.54	-3.102	57.00	-112	-379.30	0.533	58.38	-52	-250.34	3.682	47.59
-171	-304.61	-3.045	57.32	-111	-378.73	0.592	58.07	-51	-246.63	3.729	47.25
-170	-307.63	-2.988	57.61	-110	-378.11	0.649	57.75	-50	-242.88	3.776	46.90
-169	-310.59	-2.930	57.88	-109	-377.44	0.707	57.43	-49	-239.08	3.823	46.55
-168	-313.49	-2.872	58.12	-108	-376.70	0.764	57.12	-48	-235.24	3.869	46.20
-167	-316.33	-2.814	58.35	-107	-375.91	0.821	56.80	-47	-231.34	3.915	45.85
-166	-319.12	-2.755	58.56	-106	-375.06	0.878	56.49	-46	-227.41	3.961	45.50
-165	-321.84	-2.696	58.76	-105	-374.15	0.934	56.17	-45	-223.42	4.006	45.16
-164	-324.51	-2.638	58.95	-104	-373.19	0.990	55.87	-44	-219.39	4.051	44.82
-163	-327.12	-2.579	59.13	-103	-372.17	1.046	55.57	-43	-215.32	4.096	44.50
-162	-329.67	-2.519	59.30	-102	-371.10	1.101	55.27	-42	-211.20	4.140	44.19
-161	-332.16	-2.460	59.46	-101	-369.97	1.157	54.99	-41	-207.04	4.184	43.89
-160	-334.59	-2.400	59.62	-100	-368.78	1.211	54.71	-40	-202.83	4.228	43.61
-159	-336.96	-2.341	59.77	-99	-367.55	1.266	54.45	-39	-198.58	4.271	43.35
-158	-339.27	-2.281	59.92	-98	-366.25	1.320	54.19	-38	-194.29	4.315	43.11
-157	-341.52	-2.221	60.06	-97	-364.90	1.374	53.95	-37	-189.95	4.358	42.90
-156	-343.71	-2.161	60.21	-96	-363.50	1.428	53.72	-36	-185.58	4.401	42.71
-155	-345.84	-2.100	60.35	-95	-362.05	1.482	53.50	-35	-181.15	4.443	42.55
-154	-347.91	-2.040	60.49	-94	-360.54	1.535	53.30	-34	-176.69	4.486	42.41
-153	-349.92	-1.980	60.63	-93	-358.98	1.588	53.11	-33	-172.18	4.528	42.30
-152	-351.87	-1.919	60.77	-92	-357.36	1.641	52.93	-32	-167.63	4.570	42.21
-151	-353.76	-1.858	60.91	-91	-355.70	1.694	52.77	-31	-163.04	4.612	42.15
-150	-355.59	-1.797	61.04	-90	-353.97	1.747	52.62	-30	-158.41	4.655	42.11
-149	-357.35	-1.736	61.17	-89	-352.20	1.800	52.48	-29	-153.73	4.697	42.10
-148	-359.06	-1.675	61.30	-88	-350.38	1.852	52.36	-28	-149.01	4.739	42.10
-147	-360.70	-1.613	61.42	-87	-348.50	1.904	52.25	-27	-144.26	4.781	42.13
-146	-362.28	-1.552	61.54	-86	-346.57	1.956	52.16	-26	-139.45	4.823	42.16
-145	-363.80	-1.490	61.66	-85	-344.58	2.009	52.07	-25	-134.61	4.865	42.20
-144	-365.26	-1.429	61.76	-84	-342.55	2.061	51.99	-24	-129.72	4.907	42.25
-143	-366.66	-1.367	61.87	-83	-340.46	2.113	51.93	-23	-124.79	4.950	42.29
-142	-368.00	-1.305	61.96	-82	-338.32	2.164	51.87	-22	-119.82	4.992	42.33
-141	-369.27	-1.243	62.04	-81	-336.13	2.216	51.82	-21	-114.81	5.034	42.35
-140	-370.48	-1.181	62.12	-80	-333.89	2.268	51.77	-20	-109.75	5.077	42.36
-139	-371.63	-1.119	62.18	-79	-331.60	2.320	51.73	-19	-104.66	5.119	42.34
-138	-372.72	-1.056	62.24	-78	-329.25	2.372	51.70	-18	-99.52	5.161	42.29
-137	-373.75	-0.994	62.28	-77	-326.86	2.423	51.66	-17	-94.33	5.204	42.20
-136	-374.71	-0.932	62.30	-76	-324.41	2.475	51.62	-16	-89.11	5.246	42.07
-135	-375.61	-0.869	62.32	-75	-321.91	2.526	51.59	-15	-83.84	5.288	41.89
-134	-376.45	-0.807	62.32	-74	-319.35	2.578	51.55	-14	-78.53	5.329	41.67
-133	-377.22	-0.745	62.30	-73	-316.75	2.630	51.50	-13	-73.18	5.371	41.39
-132	-377.94	-0.683	62.27	-72	-314.09	2.681	51.45	-12	-67.79	5.412	41.07
-131	-378.59	-0.620	62.22	-71	-311.39	2.732	51.39	-11	-62.36	5.453	40.70
-130	-379.18	-0.558	62.16	-70	-308.63	2.784	51.32	-10	-56.89	5.494	40.29
-129	-379.70	-0.496	62.08	-69	-305.82	2.835	51.24	-9	-51.37	5.534	39.85
-128	-380.17	-0.434	61.98	-68	-302.96	2.886	51.15	-8	-45.82	5.573	39.40
-127	-380.57	-0.372	61.86	-67	-300.05	2.937	51.04	-7	-40.23	5.613	38.95
-126	-380.91	-0.310	61.73	-66	-297.08	2.988	50.93	-6	-34.59	5.651	38.54
-125	-381.19	-0.249	61.58	-65	-294.07	3.039	50.79	-5	-28.92	5.690	38.20
-124	-381.41	-0.187	61.42	-64	-291.01	3.090	50.64	-4	-23.21	5.728	37.96
-123	-381.57	-0.126	61.24	-63	-287.89	3.141	50.48	-3	-17.47	5.766	37.89
-122	-381.66	-0.065	61.04	-62	-284.72	3.191	50.30	-2	-11.68	5.804	38.03
-121	-381.70	-0.004	60.83	-61	-281.51	3.241	50.10	-1	-5.86	5.842	38.48
-120	-381.67	0.057	60.60	-60	-278.24	3.291	49.88	0	0.00	5.881	32.40

TABLE 8.4.2. Type TP thermoelements versus platinum, Pt-67—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0°C —Continued

T $^{\circ}\text{C}$	E μV	S $\mu\text{V}/^{\circ}\text{C}$	dS/dT $\text{nV}/^{\circ}\text{C}^2$	T $^{\circ}\text{C}$	E μV	S $\mu\text{V}/^{\circ}\text{C}$	dS/dT $\text{nV}/^{\circ}\text{C}^2$	T $^{\circ}\text{C}$	E μV	S $\mu\text{V}/^{\circ}\text{C}$	dS/dT $\text{nV}/^{\circ}\text{C}^2$
0	0.0	5.881	32.40	60	421.2	8.162	34.79	120	965.9	9.892	24.89
1	5.9	5.913	33.08	61	429.4	8.196	34.55	121	975.8	9.917	24.83
2	11.8	5.947	33.72	62	437.6	8.231	34.31	122	985.7	9.941	24.78
3	17.8	5.981	34.33	63	445.9	8.265	34.08	123	995.7	9.966	24.74
4	23.8	6.015	34.89	64	454.2	8.299	33.84	124	1005.6	9.991	24.69
5	29.8	6.051	35.43	65	462.5	8.333	33.60	125	1015.6	10.016	24.65
6	35.9	6.086	35.92	66	470.8	8.366	33.36	126	1025.7	10.040	24.62
7	42.0	6.122	36.39	67	479.2	8.399	33.13	127	1035.7	10.065	24.58
8	48.1	6.159	36.82	68	487.6	8.432	32.89	128	1045.8	10.089	24.55
9	54.3	6.196	37.23	69	496.1	8.465	32.66	129	1055.9	10.114	24.52
10	60.5	6.233	37.60	70	504.5	8.498	32.42	130	1066.0	10.138	24.50
11	66.8	6.271	37.94	71	513.1	8.530	32.19	131	1076.2	10.163	24.48
12	73.1	6.309	38.26	72	521.6	8.562	31.96	132	1086.3	10.187	24.46
13	79.4	6.348	38.55	73	530.2	8.594	31.73	133	1096.5	10.212	24.44
14	85.8	6.386	38.81	74	538.8	8.626	31.51	134	1106.8	10.236	24.43
15	92.2	6.425	39.05	75	547.4	8.657	31.29	135	1117.0	10.261	24.41
16	98.6	6.465	39.26	76	556.1	8.688	31.07	136	1127.3	10.285	24.41
17	105.1	6.504	39.45	77	564.8	8.719	30.85	137	1137.6	10.309	24.40
18	111.6	6.543	39.62	78	573.5	8.750	30.63	138	1147.9	10.334	24.40
19	118.2	6.583	39.77	79	582.3	8.780	30.42	139	1158.3	10.358	24.39
20	124.8	6.623	39.89	80	591.1	8.811	30.21	140	1168.6	10.383	24.39
21	131.4	6.663	39.99	81	599.9	8.841	30.00	141	1179.0	10.407	24.40
22	138.1	6.703	40.08	82	608.8	8.871	29.80	142	1189.4	10.431	24.40
23	144.8	6.743	40.14	83	617.7	8.900	29.60	143	1199.9	10.456	24.41
24	151.6	6.783	40.19	84	626.6	8.930	29.40	144	1210.3	10.480	24.42
25	158.4	6.823	40.22	85	635.5	8.959	29.21	145	1220.8	10.505	24.43
26	165.2	6.864	40.23	86	644.5	8.988	29.02	146	1231.4	10.529	24.44
27	172.1	6.904	40.23	87	653.5	9.017	28.83	147	1241.9	10.554	24.45
28	179.1	6.944	40.21	88	662.5	9.046	28.65	148	1252.5	10.578	24.47
29	186.0	6.984	40.18	89	671.6	9.074	28.47	149	1263.1	10.602	24.49
30	193.0	7.024	40.13	90	680.7	9.103	28.30	150	1273.7	10.627	24.50
31	200.1	7.065	40.07	91	689.8	9.131	28.12	151	1284.3	10.651	24.52
32	207.2	7.105	40.00	92	699.0	9.159	27.96	152	1295.0	10.676	24.54
33	214.3	7.145	39.91	93	708.1	9.187	27.79	153	1305.7	10.701	24.57
34	221.4	7.184	39.81	94	717.3	9.215	27.63	154	1316.4	10.725	24.59
35	228.6	7.224	39.70	95	726.6	9.242	27.48	155	1327.1	10.750	24.61
36	235.9	7.264	39.58	96	735.8	9.270	27.33	156	1337.9	10.774	24.64
37	243.2	7.303	39.46	97	745.1	9.297	27.18	157	1348.7	10.799	24.66
38	250.5	7.343	39.32	98	754.4	9.324	27.04	158	1359.5	10.824	24.69
39	257.9	7.382	39.17	99	763.7	9.351	26.90	159	1370.3	10.848	24.72
40	265.3	7.421	39.01	100	773.1	9.378	26.76	160	1381.2	10.873	24.75
41	272.7	7.460	38.85	101	782.5	9.405	26.63	161	1392.1	10.898	24.78
42	280.2	7.499	38.68	102	791.9	9.431	26.50	162	1403.0	10.923	24.81
43	287.7	7.537	38.50	103	801.4	9.458	26.38	163	1413.9	10.948	24.84
44	295.3	7.576	38.32	104	810.8	9.484	26.26	164	1424.9	10.972	24.87
45	302.9	7.614	38.12	105	820.3	9.510	26.14	165	1435.8	10.997	24.90
46	310.5	7.652	37.93	106	829.9	9.536	26.03	166	1446.9	11.022	24.93
47	318.2	7.690	37.73	107	839.4	9.562	25.93	167	1457.9	11.047	24.96
48	325.9	7.727	37.52	108	849.0	9.588	25.82	168	1468.9	11.072	24.99
49	333.6	7.765	37.31	109	858.6	9.614	25.72	169	1480.0	11.097	25.02
50	341.4	7.802	37.09	110	868.2	9.639	25.63	170	1491.1	11.122	25.05
51	349.2	7.839	36.87	111	877.9	9.665	25.54	171	1502.3	11.147	25.08
52	357.1	7.876	36.65	112	887.5	9.690	25.45	172	1513.4	11.172	25.11
53	365.0	7.912	36.43	113	897.2	9.716	25.37	173	1524.6	11.197	25.14
54	372.9	7.949	36.20	114	907.0	9.741	25.29	174	1535.8	11.223	25.17
55	380.9	7.985	35.97	115	916.7	9.766	25.21	175	1547.1	11.248	25.20
56	388.9	8.021	35.74	116	926.5	9.792	25.14	176	1558.3	11.273	25.23
57	396.9	8.056	35.50	117	936.3	9.817	25.07	177	1569.6	11.298	25.26
58	405.0	8.092	35.27	118	946.1	9.842	25.01	178	1580.9	11.323	25.29
59	413.1	8.127	35.03	119	956.0	9.867	24.95	179	1592.3	11.349	25.31
60	421.2	8.162	34.79	120	965.9	9.892	24.89	180	1603.6	11.374	25.34

TABLE 8.4.2. *Type TP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	1603.6	11.374	25.34	240	2332.0	12.901	24.76	300	3148.9	14.302	22.35
181	1615.0	11.399	25.37	241	2345.0	12.926	24.71	301	3163.2	14.324	22.34
182	1626.4	11.425	25.39	242	2357.9	12.950	24.67	302	3177.5	14.346	22.34
183	1637.9	11.450	25.42	243	2370.9	12.975	24.62	303	3191.9	14.369	22.34
184	1649.3	11.476	25.44	244	2383.8	13.000	24.57	304	3206.3	14.391	22.34
185	1660.8	11.501	25.47	245	2396.9	13.024	24.52	305	3220.7	14.413	22.34
186	1672.3	11.527	25.49	246	2409.9	13.049	24.47	306	3235.1	14.436	22.34
187	1683.9	11.552	25.51	247	2423.0	13.073	24.42	307	3249.6	14.458	22.34
188	1695.4	11.578	25.53	248	2436.0	13.097	24.37	308	3264.0	14.480	22.35
189	1707.0	11.603	25.55	249	2449.2	13.122	24.32	309	3278.5	14.503	22.35
190	1718.6	11.629	25.57	250	2462.3	13.146	24.26	310	3293.0	14.525	22.36
191	1730.3	11.654	25.58	251	2475.4	13.170	24.21	311	3307.6	14.547	22.37
192	1741.9	11.680	25.60	252	2488.6	13.195	24.16	312	3322.1	14.570	22.38
193	1753.6	11.705	25.61	253	2501.8	13.219	24.11	313	3336.7	14.592	22.39
194	1765.4	11.731	25.63	254	2515.1	13.243	24.05	314	3351.3	14.615	22.40
195	1777.1	11.757	25.64	255	2528.3	13.267	24.00	315	3365.9	14.637	22.42
196	1788.9	11.782	25.65	256	2541.6	13.291	23.95	316	3380.6	14.659	22.43
197	1800.7	11.808	25.66	257	2554.9	13.315	23.90	317	3395.3	14.682	22.45
198	1812.5	11.834	25.67	258	2568.2	13.339	23.84	318	3409.9	14.704	22.46
199	1824.3	11.859	25.67	259	2581.6	13.362	23.79	319	3424.7	14.727	22.48
200	1836.2	11.885	25.68	260	2595.0	13.386	23.74	320	3439.4	14.749	22.50
201	1848.1	11.911	25.68	261	2608.3	13.410	23.69	321	3454.2	14.772	22.52
202	1860.0	11.936	25.69	262	2621.8	13.433	23.63	322	3468.9	14.794	22.54
203	1872.0	11.962	25.69	263	2635.2	13.457	23.58	323	3483.7	14.817	22.56
204	1883.9	11.988	25.69	264	2648.7	13.481	23.53	324	3498.6	14.839	22.58
205	1895.9	12.013	25.69	265	2662.2	13.504	23.48	325	3513.4	14.862	22.60
206	1908.0	12.039	25.68	266	2675.7	13.528	23.43	326	3528.3	14.885	22.62
207	1920.0	12.065	25.68	267	2689.2	13.551	23.38	327	3543.2	14.907	22.64
208	1932.1	12.091	25.67	268	2702.8	13.574	23.33	328	3558.1	14.930	22.66
209	1944.2	12.116	25.67	269	2716.4	13.598	23.28	329	3573.1	14.953	22.69
210	1956.3	12.142	25.66	270	2730.0	13.621	23.23	330	3588.0	14.975	22.71
211	1968.5	12.167	25.65	271	2743.6	13.644	23.19	331	3603.0	14.998	22.72
212	1980.7	12.193	25.63	272	2757.3	13.667	23.14	332	3618.0	15.021	22.74
213	1992.9	12.219	25.62	273	2771.0	13.690	23.10	333	3633.0	15.043	22.76
214	2005.1	12.244	25.61	274	2784.7	13.713	23.05	334	3648.1	15.066	22.78
215	2017.4	12.270	25.59	275	2798.4	13.737	23.01	335	3663.2	15.089	22.79
216	2029.6	12.296	25.57	276	2812.1	13.760	22.97	336	3678.3	15.112	22.81
217	2042.0	12.321	25.55	277	2825.9	13.782	22.92	337	3693.4	15.135	22.82
218	2054.3	12.347	25.53	278	2839.7	13.805	22.88	338	3708.6	15.157	22.83
219	2066.7	12.372	25.51	279	2853.5	13.828	22.85	339	3723.7	15.180	22.84
220	2079.0	12.398	25.49	280	2867.4	13.851	22.81	340	3738.9	15.203	22.84
221	2091.4	12.423	25.46	281	2881.2	13.874	22.77	341	3754.1	15.226	22.85
222	2103.9	12.449	25.44	282	2895.1	13.897	22.74	342	3769.4	15.249	22.85
223	2116.3	12.474	25.41	283	2909.0	13.919	22.70	343	3784.6	15.272	22.85
224	2128.8	12.499	25.38	284	2922.9	13.942	22.67	344	3799.9	15.295	22.84
225	2141.3	12.525	25.35	285	2936.9	13.965	22.64	345	3815.2	15.317	22.83
226	2153.9	12.550	25.32	286	2950.9	13.987	22.61	346	3830.5	15.340	22.82
227	2166.4	12.575	25.29	287	2964.9	14.010	22.58	347	3845.9	15.363	22.80
228	2179.0	12.601	25.25	288	2978.9	14.032	22.55	348	3861.3	15.386	22.78
229	2191.6	12.626	25.22	289	2992.9	14.055	22.53	349	3876.7	15.409	22.75
230	2204.3	12.651	25.18	290	3007.0	14.077	22.50	350	3892.1	15.431	22.72
231	2216.9	12.676	25.14	291	3021.1	14.100	22.48	351	3907.5	15.454	22.68
232	2229.6	12.701	25.11	292	3035.2	14.122	22.46	352	3923.0	15.477	22.64
233	2242.3	12.727	25.07	293	3049.3	14.145	22.44	353	3938.5	15.499	22.59
234	2255.1	12.752	25.03	294	3063.5	14.167	22.42	354	3954.0	15.522	22.54
235	2267.9	12.777	24.98	295	3077.7	14.190	22.41	355	3969.5	15.544	22.47
236	2280.6	12.802	24.94	296	3091.9	14.212	22.39	356	3985.1	15.567	22.41
237	2293.5	12.826	24.90	297	3106.1	14.235	22.38	357	4000.7	15.589	22.33
238	2306.3	12.851	24.85	298	3120.3	14.257	22.37	358	4016.3	15.611	22.24
239	2319.2	12.876	24.81	299	3134.6	14.279	22.36	359	4031.9	15.634	22.15
240	2332.0	12.901	24.76	300	3148.9	14.302	22.35	360	4047.5	15.656	22.05

TABLE 8.4.2. *Type TP thermoelements versus platinum, Pt-67—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	4047.5	15.656	22.05	375	4284.8	15.968	19.15	390	4526.2	16.211	12.33
361	4063.2	15.678	21.94	376	4300.7	15.987	18.84	391	4542.4	16.223	11.68
362	4078.9	15.700	21.82	377	4316.7	16.006	18.51	392	4558.7	16.234	11.00
363	4094.6	15.721	21.69	378	4332.7	16.024	18.17	393	4574.9	16.245	10.29
364	4110.3	15.743	21.55	379	4348.8	16.042	17.81	394	4591.2	16.255	9.55
365	4126.1	15.764	21.39	380	4364.8	16.060	17.42	395	4607.4	16.264	8.77
366	4141.9	15.786	21.23	381	4380.9	16.077	17.02	396	4623.7	16.272	7.97
367	4157.6	15.807	21.05	382	4397.0	16.094	16.59	397	4640.0	16.280	7.13
368	4173.5	15.828	20.87	383	4413.1	16.110	16.14	398	4656.3	16.286	6.25
369	4189.3	15.849	20.66	384	4429.2	16.126	15.67	399	4672.5	16.292	5.34
370	4205.2	15.869	20.45	385	4445.3	16.142	15.18	400	4688.8	16.297	4.39
371	4221.0	15.890	20.22	386	4461.5	16.157	14.66				
372	4236.9	15.910	19.98	387	4477.7	16.171	14.12				
373	4252.9	15.929	19.72	388	4493.8	16.185	13.55				
374	4268.8	15.949	19.44	389	4510.0	16.198	12.95				
375	4284.8	15.968	19.15	390	4526.2	16.211	12.33				

TABLE 8.4.3. Thermoelectric values at the fixed points for Type TP thermoelements versus platinum, Pt-67

Fixed point	Temp. °C	E μV	S μV/°C	dS/dT nV/°C ²
Helium NBP	-268.935	19.92	0.171	-138.81
Hydrogen TP	-259.340	14.99	-1.185	-131.90
Hydrogen NBP	-252.870	4.71	-1.969	-110.82
Neon TP	-248.595	-4.69	-2.417	-99.00
Neon NBP	-246.048	-11.16	-2.661	-92.93
Oxygen TP	-218.789	-110.98	-4.373	-27.79
Nitrogen TP	-210.002	-150.14	-4.501	-1.43
Nitrogen NBP	-195.802	-212.90	-4.255	33.56
Oxygen NBP	-182.962	-264.20	-3.699	50.88
Carbon Dioxide SP	-78.476	-330.38	2.347	51.71
Mercury FP	-38.862	-197.99	4.277	43.32
Ice point*	0.000	0.0	5.881	32.40
Ether TP	26.870	171.2	6.899	40.23
Water BP	100.000	773.1	9.378	26.76
Benzoic TP	122.370	989.4	9.951	24.77
Indium FP	156.634	1344.7	10.790	24.66
Tin FP	231.9681	2229.2	12.701	25.11
Bismuth FP	271.442	2749.7	13.654	23.17
Cadmium FP	321.108	3455.8	14.774	22.52
Lead FP	327.502	3550.7	14.919	22.65
Mercury BP	356.660	3995.4	15.582	22.36

*Junction point of different functions.

TABLE 8.4.4. Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of Type TP thermoelements versus platinum, Pt-67

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-270 to -200 °C	14	(*)	(*)	5	4	<0.01
-200 to 0 °C	14	(*)	100	0.3	0.3	<0.01
0 to 200 °C	9	1	0.1	<0.01	<0.01	<0.01
200 to 400 °C	9	40	2	<0.01	<0.01	<0.01

*A high-order polynomial with a low-bit machine causes extreme error.

8.5. Reference Functions and Tables for Platinum, Pt-67, Versus the Negative Thermoelement, Type TN, a Copper-Nickel Alloy

The coefficients for the thirteenth degree expansion for the thermoelectric voltage of Pt-67 versus Type TN (or EN) thermoelements below 0 °C are given in table 8.5.1. The coefficients for the ninth degree expansion above 0 °C are also given in table 8.5.1. Errors caused by using reduced-bit arithmetic for calculating values of the functions are given in table 8.5.4.

The primary reference values for Pt-67 versus Type TN (or EN) thermoelements are given in table 8.5.2.

Values at selected fixed points are given in table 8.5.3. Graphs of the thermoelectric voltage, its first derivative (Seebeck coefficient), and second derivative are given in figures 8.5.1, 8.5.2, and 8.5.3, respectively.

It should be stressed that Type TN (or EN) thermocouple material that conforms closely to the high temperature tabular values may not necessarily conform closely at low temperatures (below 0 °C) and vice versa. If Type TN (or EN) thermoelements are to be used for accurate measurements both above and below 0 °C, then the material must be calibrated in the full temperature range, both above and below 0 °C. Special selection of material will usually be required.

TABLE 8.5.1. Power series expansion for the thermoelectric voltage of platinum, Pt-67, versus Type TN (or EN) thermoelements

Temperature range	Degree	Coefficients	Term
-270 to 0 °C	13	3.2860147666×10^1	T
		$2.4465371290 \times 10^{-2}$	T^2
		$-6.3070457030 \times 10^{-6}$	T^3
		$-5.0520527300 \times 10^{-7}$	T^4
		$-4.0652039120 \times 10^{-8}$	T^5
		$-1.8735086436 \times 10^{-9}$	T^6
		$-3.9193498250 \times 10^{-11}$	T^7
		$-4.6073273946 \times 10^{-13}$	T^8
		$-3.3208257016 \times 10^{-15}$	T^9
		$-1.5034792240 \times 10^{-17}$	T^{10}
		$-4.1775287263 \times 10^{-20}$	T^{11}
		$-6.5148906779 \times 10^{-23}$	T^{12}
		$-4.3671808488 \times 10^{-26}$	T^{13}
0 to 1000 °C	9	3.2860147666×10^1	T
		$1.6988793174 \times 10^{-2}$	T^2
		$9.0773681956 \times 10^{-6}$	T^3
		$-5.5610808187 \times 10^{-7}$	T^4
		$1.5431959604 \times 10^{-9}$	T^5
		$-2.4838001634 \times 10^{-12}$	T^6
		$2.3389721459 \times 10^{-15}$	T^7
		$-1.1946296815 \times 10^{-18}$	T^8
		$2.5561127497 \times 10^{-22}$	T^9

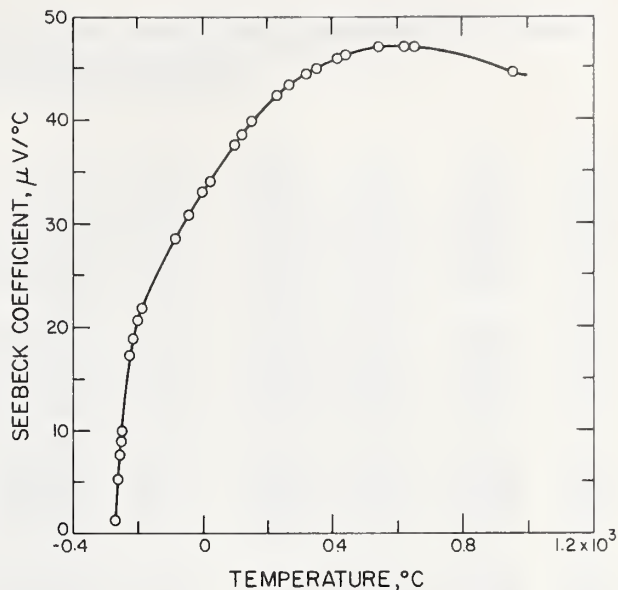


FIGURE 8.5.2. Seebeck coefficient for platinum, Pt-67, versus Type TN (or EN) thermoelements. The circles indicate values at various thermometric fixed points on the IPTS-68.

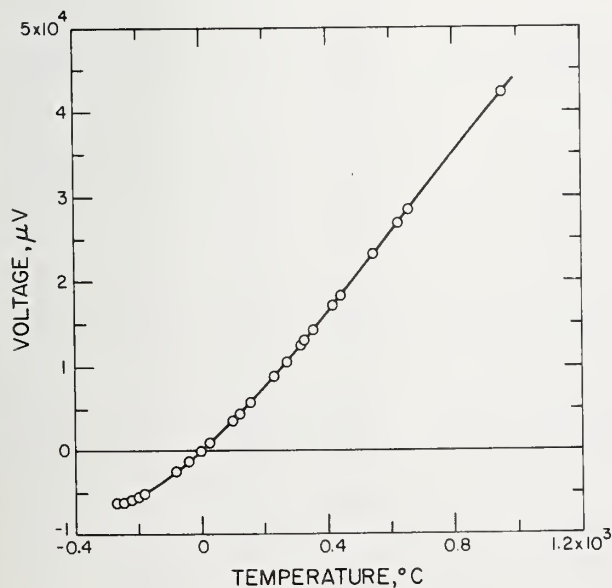


FIGURE 8.5.1. Thermoelectric voltage for platinum, Pt-67, versus Type TN (or EN) thermoelements. The circles indicate values at various thermometric fixed points on the IPTS-68.

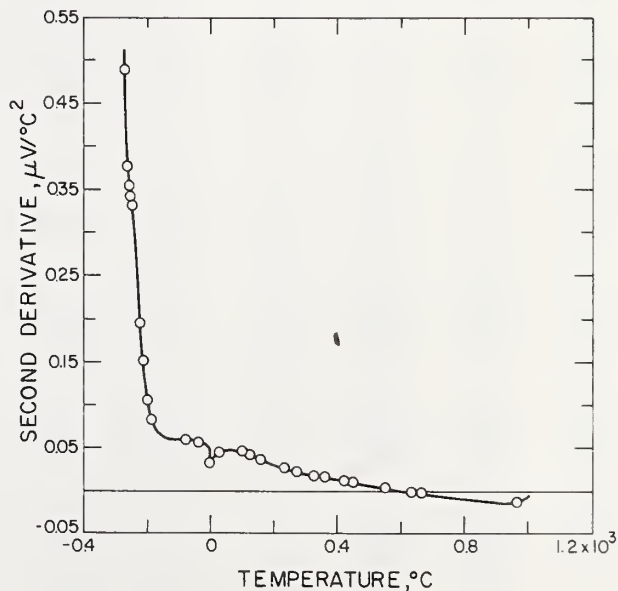


FIGURE 8.5.3. Second derivative of thermoelectric voltage for platinum, Pt-67, versus Type TN (or EN) thermoelements. The circles indicate values at various thermometric fixed points on the IPTS-68.

TABLE 8.5.2. *Platinum, Pt-67, versus Type TN (or EN) thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-270	-6277.24	0.700	517.60	-240	-6076.22	11.910	310.31	-210	-5603.10	18.806	151.01
-269	-6276.29	1.205	492.68	-239	-6064.15	12.218	305.77	-209	-5584.22	18.955	146.75
-268	-6274.84	1.686	471.14	-238	-6051.78	12.521	301.05	-208	-5565.19	19.100	142.64
-267	-6272.92	2.148	452.59	-237	-6039.11	12.820	296.16	-207	-5546.02	19.240	138.67
-266	-6270.55	2.592	436.65	-236	-6026.14	13.113	291.11	-206	-5526.71	19.377	134.85
-265	-6267.74	3.022	423.01	-235	-6012.89	13.402	285.91	-205	-5507.27	19.510	131.18
-264	-6264.51	3.439	411.36	-234	-5999.34	13.685	280.58	-204	-5487.69	19.640	127.66
-263	-6260.87	3.845	401.43	-233	-5985.52	13.963	275.14	-203	-5467.99	19.765	124.28
-262	-6256.82	4.242	392.97	-232	-5971.42	14.235	269.59	-202	-5448.16	19.888	121.04
-261	-6252.39	4.632	385.78	-231	-5957.05	14.502	263.96	-201	-5428.22	20.008	117.95
-260	-6247.56	5.014	379.63	-230	-5942.42	14.763	258.26	-200	-5408.15	20.124	115.00
-259	-6242.36	5.391	374.37	-229	-5927.52	15.019	252.51	-199	-5387.97	20.238	112.19
-258	-6236.78	5.763	369.82	-228	-5912.38	15.268	246.72	-198	-5367.68	20.348	109.51
-257	-6230.83	6.131	365.85	-227	-5896.99	15.512	240.91	-197	-5347.27	20.457	106.96
-256	-6224.52	6.495	362.33	-226	-5881.36	15.750	235.09	-196	-5326.76	20.562	104.54
-255	-6217.85	6.856	359.15	-225	-5865.49	15.982	229.28	-195	-5306.15	20.666	102.24
-254	-6210.81	7.214	356.21	-224	-5849.39	16.209	223.50	-194	-5285.43	20.767	100.06
-253	-6203.42	7.568	353.42	-223	-5833.08	16.429	217.74	-193	-5264.61	20.866	98.00
-252	-6195.68	7.920	350.73	-222	-5816.54	16.644	212.04	-192	-5243.70	20.963	96.05
-251	-6187.58	8.270	348.05	-221	-5799.79	16.853	206.40	-191	-5222.69	21.058	94.21
-250	-6179.14	8.616	345.34	-220	-5782.83	17.057	200.83	-190	-5201.58	21.151	92.47
-249	-6170.35	8.960	342.56	-219	-5765.68	17.255	195.34	-189	-5180.39	21.243	90.83
-248	-6161.22	9.302	339.67	-218	-5748.32	17.448	189.95	-188	-5159.10	21.333	89.28
-247	-6151.75	9.640	336.65	-217	-5730.78	17.635	184.65	-187	-5137.72	21.422	87.81
-246	-6141.94	9.975	333.45	-216	-5713.06	17.817	179.47	-186	-5116.26	21.509	86.44
-245	-6131.80	10.307	330.09	-215	-5695.15	17.994	174.40	-185	-5094.70	21.595	85.14
-244	-6121.33	10.635	326.53	-214	-5677.07	18.166	169.46	-184	-5073.07	21.679	83.92
-243	-6110.53	10.960	322.77	-213	-5658.82	18.333	164.64	-183	-5051.35	21.762	82.76
-242	-6099.41	11.280	318.82	-212	-5640.41	18.495	159.96	-182	-5029.54	21.845	81.68
-241	-6087.97	11.597	314.66	-211	-5621.83	18.653	155.42	-181	-5007.66	21.926	80.65
-240	-6076.22	11.910	310.31	-210	-5603.10	18.806	151.01	-180	-4985.69	22.006	79.69

TABLE 8.5.2. *Platinum, Pt-67, versus Type TN (or EN) thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
-180	-4985.69	22.006	79.69	-120	-3540.95	25.969	60.34	-60	-1874.17	29.549	56.67
-179	-4963.65	22.085	78.78	-119	-3514.96	26.029	60.36	-59	-1844.59	29.605	56.60
-178	-4941.52	22.164	77.92	-118	-3488.90	26.090	60.38	-58	-1814.96	29.662	56.55
-177	-4919.32	22.241	77.10	-117	-3462.78	26.150	60.42	-57	-1785.27	29.718	56.50
-176	-4897.04	22.318	76.34	-116	-3436.60	26.211	60.45	-56	-1755.52	29.775	56.46
-175	-4874.68	22.394	75.61	-115	-3410.35	26.271	60.49	-55	-1725.72	29.831	56.43
-174	-4852.25	22.469	74.91	-114	-3384.05	26.332	60.53	-54	-1695.86	29.888	56.41
-173	-4829.75	22.544	74.26	-113	-3357.69	26.392	60.58	-53	-1665.94	29.944	56.40
-172	-4807.17	22.618	73.63	-112	-3331.27	26.453	60.62	-52	-1635.97	30.001	56.40
-171	-4784.51	22.691	73.03	-111	-3304.79	26.513	60.67	-51	-1605.94	30.057	56.41
-170	-4761.78	22.764	72.46	-110	-3278.24	26.574	60.71	-50	-1575.86	30.113	56.42
-169	-4738.98	22.836	71.91	-109	-3251.64	26.635	60.75	-49	-1545.72	30.170	56.45
-168	-4716.11	22.907	71.39	-108	-3224.97	26.696	60.80	-48	-1515.52	30.226	56.48
-167	-4693.17	22.979	70.89	-107	-3198.25	26.756	60.83	-47	-1485.26	30.283	56.51
-166	-4670.16	23.049	70.40	-106	-3171.46	26.817	60.87	-46	-1454.95	30.339	56.55
-165	-4647.07	23.119	69.93	-105	-3144.61	26.878	60.90	-45	-1424.59	30.396	56.59
-164	-4623.92	23.189	69.48	-104	-3117.70	26.939	60.93	-44	-1394.16	30.453	56.64
-163	-4600.69	23.258	69.04	-103	-3090.73	27.000	60.95	-43	-1363.68	30.509	56.68
-162	-4577.40	23.327	68.62	-102	-3063.70	27.061	60.96	-42	-1333.14	30.566	56.73
-161	-4554.04	23.396	68.21	-101	-3036.61	27.122	60.97	-41	-1302.55	30.623	56.78
-160	-4530.61	23.464	67.81	-100	-3009.46	27.183	60.98	-40	-1271.90	30.679	56.82
-159	-4507.11	23.531	67.42	-99	-2982.25	27.244	60.97	-39	-1241.19	30.736	56.86
-158	-4483.55	23.598	67.04	-98	-2954.97	27.305	60.96	-38	-1210.43	30.793	56.90
-157	-4459.91	23.665	66.67	-97	-2927.64	27.366	60.94	-37	-1179.60	30.850	56.93
-156	-4436.22	23.732	66.31	-96	-2900.24	27.427	60.91	-36	-1148.73	30.907	56.95
-155	-4412.45	23.798	65.96	-95	-2872.78	27.488	60.87	-35	-1117.79	30.964	56.97
-154	-4388.62	23.864	65.62	-94	-2845.26	27.548	60.82	-34	-1086.80	31.021	56.97
-153	-4364.72	23.929	65.29	-93	-2817.69	27.609	60.77	-33	-1055.75	31.078	56.97
-152	-4340.76	23.994	64.97	-92	-2790.05	27.670	60.70	-32	-1024.64	31.135	56.95
-151	-4316.74	24.059	64.66	-91	-2762.35	27.731	60.63	-31	-993.48	31.192	56.92
-150	-4292.64	24.124	64.36	-90	-2734.58	27.791	60.55	-30	-962.26	31.249	56.87
-149	-4268.49	24.188	64.07	-89	-2706.76	27.852	60.46	-29	-930.98	31.306	56.81
-148	-4244.27	24.252	63.78	-88	-2678.88	27.912	60.36	-28	-899.65	31.362	56.73
-147	-4219.99	24.315	63.51	-87	-2650.94	27.972	60.26	-27	-868.26	31.419	56.64
-146	-4195.64	24.379	63.25	-86	-2622.94	28.033	60.15	-26	-836.81	31.476	56.53
-145	-4171.23	24.442	62.99	-85	-2594.87	28.093	60.03	-25	-805.30	31.532	56.40
-144	-4146.75	24.505	62.75	-84	-2566.75	28.153	59.90	-24	-773.74	31.588	56.25
-143	-4122.22	24.567	62.52	-83	-2538.57	28.213	59.77	-23	-742.13	31.645	56.08
-142	-4097.62	24.630	62.30	-82	-2510.33	28.272	59.63	-22	-710.46	31.701	55.90
-141	-4072.96	24.692	62.09	-81	-2482.02	28.332	59.49	-21	-678.73	31.756	55.70
-140	-4048.24	24.754	61.89	-80	-2453.66	28.391	59.34	-20	-646.94	31.812	55.48
-139	-4023.45	24.816	61.71	-79	-2425.24	28.451	59.19	-19	-615.10	31.867	55.24
-138	-3998.60	24.877	61.53	-78	-2396.76	28.510	59.04	-18	-583.21	31.922	54.98
-137	-3973.70	24.939	61.37	-77	-2368.22	28.569	58.88	-17	-551.26	31.977	54.72
-136	-3948.73	25.000	61.22	-76	-2339.62	28.627	58.73	-16	-519.25	32.032	54.43
-135	-3923.70	25.061	61.08	-75	-2310.97	28.686	58.57	-15	-487.20	32.086	54.14
-134	-3898.60	25.122	60.96	-74	-2282.25	28.745	58.41	-14	-455.08	32.140	53.83
-133	-3873.45	25.183	60.84	-73	-2253.48	28.803	58.26	-13	-422.91	32.194	53.51
-132	-3848.24	25.244	60.74	-72	-2224.65	28.861	58.10	-12	-390.69	32.247	53.18
-131	-3822.96	25.305	60.65	-71	-2195.76	28.919	57.95	-11	-358.42	32.300	52.84
-130	-3797.63	25.365	60.57	-70	-2166.81	28.977	57.80	-10	-326.09	32.353	52.50
-129	-3772.23	25.426	60.50	-69	-2137.80	29.035	57.66	-9	-293.72	32.405	52.15
-128	-3746.78	25.486	60.45	-68	-2108.74	29.092	57.52	-8	-261.28	32.457	51.80
-127	-3721.26	25.547	60.40	-67	-2079.62	29.150	57.39	-7	-228.80	32.509	51.45
-126	-3695.68	25.607	60.36	-66	-2050.44	29.207	57.26	-6	-196.27	32.560	51.10
-125	-3670.05	25.667	60.34	-65	-2021.20	29.264	57.14	-5	-163.68	32.611	50.74
-124	-3644.35	25.728	60.32	-64	-1991.91	29.321	57.03	-4	-131.05	32.661	50.39
-123	-3618.59	25.788	60.31	-63	-1962.56	29.378	56.93	-3	-98.36	32.712	50.03
-122	-3592.77	25.848	60.31	-62	-1933.15	29.435	56.83	-2	-65.62	32.762	49.67
-121	-3566.89	25.909	60.32	-61	-1903.69	29.492	56.75	-1	-32.84	32.811	49.30
-120	-3540.95	25.969	60.34	-60	-1874.17	29.549	56.67	0	0.00	32.860	33.98

TABLE 8.5.2. *Platinum, Pt-67, versus Type TN (or EN) thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
0	0.0	32.860	33.98	60	2046.3	35.488	48.41	120	4261.2	38.290	43.37
1	32.9	32.894	34.52	61	2081.8	35.536	48.42	121	4299.5	38.333	43.23
2	65.8	32.929	35.04	62	2117.3	35.585	48.43	122	4337.8	38.376	43.08
3	98.7	32.964	35.55	63	2152.9	35.633	48.44	123	4376.2	38.419	42.93
4	131.7	33.000	36.05	64	2188.6	35.682	48.44	124	4414.7	38.462	42.78
5	164.7	33.037	36.54	65	2224.3	35.730	48.44	125	4453.2	38.505	42.63
6	197.8	33.073	37.01	66	2260.1	35.778	48.43	126	4491.7	38.547	42.48
7	230.9	33.111	37.47	67	2295.9	35.827	48.42	127	4530.3	38.590	42.32
8	264.0	33.148	37.92	68	2331.7	35.875	48.40	128	4568.9	38.632	42.17
9	297.2	33.186	38.36	69	2367.6	35.924	48.38	129	4607.5	38.674	42.02
10	330.4	33.225	38.79	70	2403.6	35.972	48.36	130	4646.2	38.716	41.86
11	363.6	33.264	39.20	71	2439.6	36.020	48.33	131	4684.9	38.758	41.71
12	396.9	33.303	39.60	72	2475.6	36.069	48.30	132	4723.7	38.799	41.55
13	430.2	33.343	40.00	73	2511.7	36.117	48.26	133	4762.5	38.841	41.40
14	463.6	33.383	40.38	74	2547.8	36.165	48.22	134	4801.4	38.882	41.24
15	497.0	33.424	40.75	75	2584.0	36.213	48.17	135	4840.3	38.923	41.09
16	530.4	33.465	41.11	76	2620.3	36.262	48.12	136	4879.3	38.964	40.93
17	563.9	33.506	41.45	77	2656.5	36.310	48.07	137	4918.2	39.005	40.77
18	597.5	33.548	41.79	78	2692.9	36.358	48.02	138	4957.3	39.046	40.61
19	631.0	33.590	42.12	79	2729.3	36.406	47.96	139	4996.3	39.086	40.45
20	664.6	33.632	42.44	80	2765.7	36.454	47.89	140	5035.4	39.127	40.30
21	698.3	33.675	42.74	81	2802.2	36.501	47.83	141	5074.6	39.167	40.14
22	732.0	33.718	43.04	82	2838.7	36.549	47.76	142	5113.8	39.207	39.98
23	765.7	33.761	43.33	83	2875.3	36.597	47.69	143	5153.0	39.247	39.82
24	799.5	33.804	43.61	84	2911.9	36.645	47.61	144	5192.3	39.287	39.66
25	833.3	33.848	43.88	85	2948.6	36.692	47.53	145	5231.6	39.326	39.50
26	867.2	33.892	44.14	86	2985.3	36.740	47.45	146	5270.9	39.366	39.34
27	901.1	33.936	44.39	87	3022.0	36.787	47.37	147	5310.3	39.405	39.18
28	935.1	33.981	44.63	88	3058.8	36.834	47.28	148	5349.7	39.444	39.02
29	969.1	34.025	44.86	89	3095.7	36.882	47.19	149	5389.2	39.483	38.86
30	1003.1	34.070	45.09	90	3132.6	36.929	47.10	150	5428.7	39.522	38.70
31	1037.2	34.116	45.30	91	3169.6	36.976	47.00	151	5468.2	39.560	38.54
32	1071.4	34.161	45.51	92	3206.6	37.023	46.91	152	5507.8	39.599	38.38
33	1105.5	34.207	45.71	93	3243.6	37.070	46.80	153	5547.4	39.637	38.22
34	1139.8	34.252	45.90	94	3280.7	37.116	46.70	154	5587.1	39.675	38.06
35	1174.1	34.298	46.08	95	3317.8	37.163	46.60	155	5626.8	39.713	37.90
36	1208.4	34.345	46.26	96	3355.0	37.210	46.49	156	5666.5	39.751	37.74
37	1242.7	34.391	46.42	97	3392.3	37.256	46.38	157	5706.3	39.789	37.58
38	1277.2	34.437	46.58	98	3429.5	37.302	46.27	158	5746.1	39.826	37.42
39	1311.6	34.484	46.74	99	3466.9	37.349	46.15	159	5785.9	39.864	37.26
40	1346.1	34.531	46.88	100	3504.2	37.395	46.04	160	5825.8	39.901	37.10
41	1380.7	34.578	47.02	101	3541.7	37.441	45.92	161	5865.7	39.938	36.94
42	1415.3	34.625	47.15	102	3579.1	37.487	45.80	162	5905.7	39.975	36.78
43	1449.9	34.672	47.27	103	3616.6	37.532	45.68	163	5945.7	40.011	36.62
44	1484.6	34.719	47.39	104	3654.2	37.578	45.56	164	5985.7	40.048	36.46
45	1519.4	34.767	47.50	105	3691.8	37.623	45.43	165	6025.8	40.084	36.30
46	1554.2	34.814	47.60	106	3729.4	37.669	45.30	166	6065.9	40.121	36.15
47	1589.0	34.862	47.70	107	3767.1	37.714	45.17	167	6106.0	40.157	35.99
48	1623.9	34.910	47.79	108	3804.9	37.759	45.04	168	6146.2	40.192	35.83
49	1658.8	34.958	47.87	109	3842.6	37.804	44.91	169	6186.4	40.228	35.67
50	1693.8	35.006	47.95	110	3880.5	37.849	44.78	170	6226.7	40.264	35.52
51	1728.8	35.054	48.02	111	3918.3	37.894	44.64	171	6266.9	40.299	35.36
52	1763.9	35.102	48.09	112	3956.3	37.938	44.51	172	6307.3	40.335	35.21
53	1799.0	35.150	48.14	113	3994.2	37.983	44.37	173	6347.6	40.370	35.05
54	1834.2	35.198	48.20	114	4032.2	38.027	44.23	174	6388.0	40.405	34.89
55	1869.4	35.246	48.25	115	4070.3	38.071	44.09	175	6428.4	40.439	34.74
56	1904.7	35.294	48.29	116	4108.4	38.115	43.95	176	6468.9	40.474	34.59
57	1940.0	35.343	48.33	117	4146.5	38.159	43.81	177	6509.4	40.509	34.43
58	1975.4	35.391	48.36	118	4184.7	38.203	43.66	178	6549.9	40.543	34.28
59	2010.8	35.439	48.39	119	4222.9	38.246	43.52	179	6590.5	40.577	34.13
60	2046.3	35.488	48.41	120	4261.2	38.290	43.37	180	6631.0	40.611	33.97

TABLE 8.5.2. *Platinum, Pt-67, versus Type TN (or EN) thermoelements—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
180	6631.0	40.611	33.97	240	9123.7	42.399	26.03	300	11710.9	43.785	20.51
181	6671.7	40.645	33.82	241	9166.2	42.425	25.92	301	11754.7	43.805	20.43
182	6712.3	40.679	33.67	242	9208.6	42.451	25.81	302	11798.5	43.826	20.35
183	6753.0	40.713	33.52	243	9251.1	42.477	25.71	303	11842.4	43.846	20.28
184	6793.8	40.746	33.37	244	9293.5	42.502	25.60	304	11886.2	43.866	20.20
185	6834.5	40.779	33.22	245	9336.1	42.528	25.49	305	11930.1	43.886	20.13
186	6875.3	40.812	33.07	246	9378.6	42.553	25.38	306	11974.0	43.907	20.05
187	6916.1	40.845	32.92	247	9421.2	42.579	25.28	307	12017.9	43.927	19.98
188	6957.0	40.878	32.78	248	9463.8	42.604	25.17	308	12061.8	43.947	19.91
189	6997.9	40.911	32.63	249	9506.4	42.629	25.06	309	12105.8	43.966	19.83
190	7038.8	40.944	32.48	250	9549.0	42.654	24.96	310	12149.8	43.986	19.76
191	7079.8	40.976	32.34	251	9591.7	42.679	24.86	311	12193.8	44.006	19.69
192	7120.8	41.008	32.19	252	9634.4	42.704	24.75	312	12237.8	44.026	19.62
193	7161.8	41.040	32.05	253	9677.1	42.728	24.65	313	12281.8	44.045	19.54
194	7202.9	41.072	31.90	254	9719.8	42.753	24.55	314	12325.9	44.065	19.47
195	7244.0	41.104	31.76	255	9762.6	42.777	24.45	315	12369.9	44.084	19.40
196	7285.1	41.136	31.62	256	9805.4	42.802	24.35	316	12414.0	44.103	19.33
197	7326.2	41.167	31.48	257	9848.2	42.826	24.25	317	12458.2	44.123	19.26
198	7367.4	41.199	31.33	258	9891.0	42.850	24.15	318	12502.3	44.142	19.19
199	7408.6	41.230	31.19	259	9933.9	42.874	24.05	319	12546.4	44.161	19.12
200	7449.9	41.261	31.05	260	9976.8	42.898	23.95	320	12590.6	44.180	19.05
201	7491.1	41.292	30.91	261	10019.7	42.922	23.86	321	12634.8	44.199	18.98
202	7532.5	41.323	30.77	262	10062.6	42.946	23.76	322	12679.0	44.218	18.91
203	7573.8	41.354	30.64	263	10105.6	42.970	23.66	323	12723.2	44.237	18.84
204	7615.2	41.384	30.50	264	10148.6	42.993	23.57	324	12767.5	44.256	18.77
205	7656.6	41.415	30.36	265	10191.6	43.017	23.47	325	12811.7	44.275	18.70
206	7698.0	41.445	30.23	266	10234.6	43.040	23.38	326	12856.0	44.293	18.64
207	7739.4	41.475	30.09	267	10277.7	43.064	23.29	327	12900.3	44.312	18.57
208	7780.9	41.505	29.96	268	10320.7	43.087	23.19	328	12944.7	44.330	18.50
209	7822.5	41.535	29.82	269	10363.8	43.110	23.10	329	12989.0	44.349	18.43
210	7864.0	41.565	29.69	270	10407.0	43.133	23.01	330	13033.4	44.367	18.37
211	7905.6	41.594	29.56	271	10450.1	43.156	22.92	331	13077.7	44.386	18.30
212	7947.2	41.624	29.43	272	10493.3	43.179	22.83	332	13122.1	44.404	18.23
213	7988.8	41.653	29.29	273	10536.5	43.202	22.74	333	13166.5	44.422	18.17
214	8030.5	41.682	29.16	274	10579.7	43.225	22.65	334	13211.0	44.440	18.10
215	8072.2	41.712	29.04	275	10622.9	43.247	22.56	335	13255.4	44.458	18.03
216	8113.9	41.741	28.91	276	10666.2	43.270	22.47	336	13299.9	44.476	17.97
217	8155.7	41.769	28.78	277	10709.4	43.292	22.38	337	13344.4	44.494	17.90
218	8197.5	41.798	28.65	278	10752.7	43.314	22.30	338	13388.9	44.512	17.83
219	8239.3	41.827	28.52	279	10796.1	43.337	22.21	339	13433.4	44.530	17.77
220	8281.1	41.855	28.40	280	10839.4	43.359	22.13	340	13477.9	44.548	17.70
221	8323.0	41.884	28.27	281	10882.8	43.381	22.04	341	13522.5	44.565	17.64
222	8364.9	41.912	28.15	282	10926.2	43.403	21.95	342	13567.1	44.583	17.57
223	8406.8	41.940	28.03	283	10969.6	43.425	21.87	343	13611.7	44.600	17.51
224	8448.8	41.968	27.90	284	11013.0	43.447	21.79	344	13656.3	44.618	17.44
225	8490.7	41.996	27.78	285	11056.5	43.468	21.70	345	13700.9	44.635	17.38
226	8532.8	42.023	27.66	286	11100.0	43.490	21.62	346	13745.5	44.653	17.32
227	8574.8	42.051	27.54	287	11143.5	43.512	21.54	347	13790.2	44.670	17.25
228	8616.9	42.078	27.42	288	11187.0	43.533	21.46	348	13834.9	44.687	17.19
229	8659.0	42.106	27.30	289	11230.5	43.555	21.37	349	13879.6	44.704	17.12
230	8701.1	42.133	27.18	290	11274.1	43.576	21.29	350	13924.3	44.721	17.06
231	8743.2	42.160	27.06	291	11317.7	43.597	21.21	351	13969.0	44.738	17.00
232	8785.4	42.187	26.95	292	11361.3	43.618	21.13	352	14013.8	44.755	16.93
233	8827.6	42.214	26.83	293	11404.9	43.639	21.05	353	14058.5	44.772	16.87
234	8869.8	42.241	26.71	294	11448.6	43.660	20.97	354	14103.3	44.789	16.80
235	8912.1	42.267	26.60	295	11492.2	43.681	20.89	355	14148.1	44.806	16.74
236	8954.4	42.294	26.48	296	11535.9	43.702	20.82	356	14192.9	44.823	16.68
237	8996.7	42.320	26.37	297	11579.6	43.723	20.74	357	14237.7	44.839	16.61
238	9039.0	42.347	26.26	298	11623.4	43.744	20.66	358	14282.6	44.856	16.55
239	9081.4	42.373	26.15	299	11667.1	43.764	20.58	359	14327.5	44.872	16.49
240	9123.7	42.399	26.03	300	11710.9	43.785	20.51	360	14372.3	44.889	16.42

TABLE 8.5.2. *Platinum, Pt-67, versus Type TN (or EN) thermoelements—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
360	14372.3	44.889	16.42	420	17093.0	45.761	12.64	480	19859.0	46.400	8.61
361	14417.2	44.905	16.36	421	17138.7	45.774	12.58	481	19905.4	46.409	8.54
362	14462.1	44.922	16.30	422	17184.5	45.786	12.51	482	19951.8	46.417	8.47
363	14507.1	44.938	16.24	423	17230.3	45.799	12.45	483	19998.3	46.426	8.40
364	14552.0	44.954	16.17	424	17276.1	45.811	12.38	484	20044.7	46.434	8.33
365	14597.0	44.970	16.11	425	17321.9	45.824	12.32	485	20091.1	46.442	8.26
366	14642.0	44.986	16.05	426	17367.8	45.836	12.25	486	20137.6	46.451	8.19
367	14687.0	45.002	15.99	427	17413.6	45.848	12.18	487	20184.0	46.459	8.12
368	14732.0	45.018	15.92	428	17459.5	45.860	12.12	488	20230.5	46.467	8.05
369	14777.0	45.034	15.86	429	17505.3	45.872	12.05	489	20277.0	46.475	7.98
370	14822.0	45.050	15.80	430	17551.2	45.884	11.99	490	20323.5	46.483	7.91
371	14867.1	45.066	15.74	431	17597.1	45.896	11.92	491	20369.9	46.491	7.84
372	14912.2	45.081	15.67	432	17643.0	45.908	11.86	492	20416.4	46.498	7.78
373	14957.3	45.097	15.61	433	17688.9	45.920	11.79	493	20462.9	46.506	7.71
374	15002.4	45.113	15.55	434	17734.8	45.932	11.73	494	20509.4	46.514	7.64
375	15047.5	45.128	15.49	435	17780.8	45.944	11.66	495	20556.0	46.521	7.57
376	15092.6	45.144	15.42	436	17826.7	45.955	11.59	496	20602.5	46.529	7.50
377	15137.8	45.159	15.36	437	17872.7	45.967	11.53	497	20649.0	46.536	7.43
378	15182.9	45.174	15.30	438	17918.7	45.978	11.46	498	20695.6	46.544	7.36
379	15228.1	45.190	15.24	439	17964.6	45.990	11.39	499	20742.1	46.551	7.29
380	15273.3	45.205	15.17	440	18010.6	46.001	11.33	500	20788.7	46.558	7.22
381	15318.5	45.220	15.11	441	18056.6	46.012	11.26	501	20835.2	46.566	7.15
382	15363.8	45.235	15.05	442	18102.7	46.024	11.19	502	20881.8	46.573	7.08
383	15409.0	45.250	14.99	443	18148.7	46.035	11.13	503	20928.4	46.580	7.01
384	15454.3	45.265	14.92	444	18194.7	46.046	11.06	504	20975.0	46.587	6.94
385	15499.5	45.280	14.86	445	18240.8	46.057	10.99	505	21021.5	46.594	6.87
386	15544.8	45.295	14.80	446	18286.9	46.068	10.93	506	21068.1	46.600	6.80
387	15590.1	45.309	14.74	447	18332.9	46.079	10.86	507	21114.7	46.607	6.74
388	15635.4	45.324	14.67	448	18379.0	46.090	10.79	508	21161.4	46.614	6.67
389	15680.8	45.339	14.61	449	18425.1	46.100	10.73	509	21208.0	46.621	6.60
390	15726.1	45.353	14.55	450	18471.2	46.111	10.66	510	21254.6	46.627	6.53
391	15771.5	45.368	14.48	451	18517.3	46.122	10.59	511	21301.2	46.634	6.46
392	15816.8	45.382	14.42	452	18563.5	46.132	10.52	512	21347.9	46.640	6.39
393	15862.2	45.397	14.36	453	18609.6	46.143	10.46	513	21394.5	46.646	6.32
394	15907.6	45.411	14.30	454	18655.7	46.153	10.39	514	21441.2	46.653	6.25
395	15953.1	45.425	14.23	455	18701.9	46.163	10.32	515	21487.8	46.659	6.18
396	15998.5	45.440	14.17	456	18748.1	46.174	10.25	516	21534.5	46.665	6.11
397	16043.9	45.454	14.11	457	18794.2	46.184	10.19	517	21581.1	46.671	6.05
398	16089.4	45.468	14.04	458	18840.4	46.194	10.12	518	21627.8	46.677	5.98
399	16134.9	45.482	13.98	459	18886.6	46.204	10.05	519	21674.5	46.683	5.91
400	16180.4	45.496	13.92	460	18932.8	46.214	9.98	520	21721.2	46.689	5.84
401	16225.9	45.510	13.85	461	18979.1	46.224	9.91	521	21767.9	46.695	5.77
402	16271.4	45.523	13.79	462	19025.3	46.234	9.85	522	21814.6	46.701	5.70
403	16316.9	45.537	13.73	463	19071.5	46.244	9.78	523	21861.3	46.706	5.63
404	16362.5	45.551	13.66	464	19117.8	46.254	9.71	524	21908.0	46.712	5.57
405	16408.0	45.564	13.60	465	19164.0	46.263	9.64	525	21954.7	46.717	5.50
406	16453.6	45.578	13.54	466	19210.3	46.273	9.57	526	22001.4	46.723	5.43
407	16499.2	45.592	13.47	467	19256.6	46.282	9.50	527	22048.1	46.728	5.36
408	16544.8	45.605	13.41	468	19302.9	46.292	9.43	528	22094.9	46.734	5.29
409	16590.4	45.618	13.35	469	19349.2	46.301	9.37	529	22141.6	46.739	5.23
410	16636.0	45.632	13.28	470	19395.5	46.311	9.30	530	22188.4	46.744	5.16
411	16681.6	45.645	13.22	471	19441.8	46.320	9.23	531	22235.1	46.749	5.09
412	16727.3	45.658	13.15	472	19488.1	46.329	9.16	532	22281.9	46.754	5.02
413	16773.0	45.671	13.09	473	19534.4	46.338	9.09	533	22328.6	46.759	4.95
414	16818.6	45.684	13.03	474	19580.8	46.347	9.02	534	22375.4	46.764	4.89
415	16864.3	45.697	12.96	475	19627.1	46.356	8.95	535	22422.1	46.769	4.82
416	16910.0	45.710	12.90	476	19673.5	46.365	8.88	536	22468.9	46.774	4.75
417	16955.7	45.723	12.83	477	19719.9	46.374	8.81	537	22515.7	46.778	4.69
418	17001.5	45.736	12.77	478	19766.2	46.383	8.75	538	22562.5	46.783	4.62
419	17047.2	45.749	12.70	479	19812.6	46.391	8.68	539	22609.2	46.788	4.55
420	17093.0	45.761	12.64	480	19859.0	46.400	8.61	540	22656.0	46.792	4.49

TABLE 8.5.2. *Platinum, Pt-67, versus Type TN (or EN) thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
540	22656.0	46.792	4.49	600	25469.3	46.947	0.81	660	28285.8	46.906	-2.03
541	22702.8	46.797	4.42	601	25516.3	46.948	0.75	661	28332.7	46.904	-2.07
542	22749.6	46.801	4.35	602	25563.2	46.949	0.70	662	28379.6	46.902	-2.11
543	22796.4	46.805	4.29	603	25610.2	46.950	0.64	663	28426.5	46.900	-2.15
544	22843.2	46.810	4.22	604	25657.1	46.950	0.59	664	28473.4	46.898	-2.19
545	22890.1	46.814	4.15	605	25704.1	46.951	0.53	665	28520.3	46.895	-2.23
546	22936.9	46.818	4.09	606	25751.0	46.951	0.48	666	28567.2	46.893	-2.27
547	22983.7	46.822	4.02	607	25798.0	46.952	0.43	667	28614.1	46.891	-2.31
548	23030.5	46.826	3.96	608	25844.9	46.952	0.38	668	28661.0	46.889	-2.34
549	23077.3	46.830	3.89	609	25891.9	46.952	0.32	669	28707.9	46.886	-2.38
550	23124.2	46.834	3.83	610	25938.8	46.953	0.27	670	28754.7	46.884	-2.42
551	23171.0	46.838	3.76	611	25985.8	46.953	0.22	671	28801.6	46.881	-2.46
552	23217.8	46.841	3.70	612	26032.7	46.953	0.17	672	28848.5	46.879	-2.50
553	23264.7	46.845	3.63	613	26079.7	46.953	0.11	673	28895.4	46.876	-2.53
554	23311.5	46.849	3.57	614	26126.6	46.953	0.06	674	28942.3	46.874	-2.57
555	23358.4	46.852	3.50	615	26173.6	46.953	0.01	675	28989.1	46.871	-2.61
556	23405.2	46.856	3.44	616	26220.6	46.953	-0.04	676	29036.0	46.869	-2.65
557	23452.1	46.859	3.37	617	26267.5	46.953	-0.09	677	29082.9	46.866	-2.68
558	23499.0	46.862	3.31	618	26314.5	46.953	-0.14	678	29129.7	46.863	-2.72
559	23545.8	46.866	3.25	619	26361.4	46.953	-0.19	679	29176.6	46.861	-2.76
560	23592.7	46.869	3.18	620	26408.4	46.953	-0.24	680	29223.5	46.858	-2.79
561	23639.6	46.872	3.12	621	26455.3	46.953	-0.29	681	29270.3	46.855	-2.83
562	23686.4	46.875	3.06	622	26502.3	46.952	-0.34	682	29317.2	46.852	-2.87
563	23733.3	46.878	2.99	623	26549.2	46.952	-0.39	683	29364.0	46.849	-2.90
564	23780.2	46.881	2.93	624	26596.2	46.952	-0.44	684	29410.9	46.846	-2.94
565	23827.1	46.884	2.87	625	26643.1	46.951	-0.49	685	29457.7	46.843	-2.97
566	23874.0	46.887	2.80	626	26690.1	46.951	-0.53	686	29504.5	46.840	-3.01
567	23920.8	46.889	2.74	627	26737.0	46.950	-0.58	687	29551.4	46.837	-3.04
568	23967.7	46.892	2.68	628	26784.0	46.949	-0.63	688	29598.2	46.834	-3.08
569	24014.6	46.895	2.62	629	26830.9	46.949	-0.68	689	29645.1	46.831	-3.11
570	24061.5	46.897	2.56	630	26877.9	46.948	-0.72	690	29691.9	46.828	-3.15
571	24108.4	46.900	2.50	631	26924.8	46.947	-0.77	691	29738.7	46.825	-3.18
572	24155.3	46.902	2.43	632	26971.8	46.946	-0.82	692	29785.5	46.822	-3.22
573	24202.2	46.905	2.37	633	27018.7	46.946	-0.87	693	29832.4	46.818	-3.25
574	24249.1	46.907	2.31	634	27065.7	46.945	-0.91	694	29879.2	46.815	-3.29
575	24296.0	46.909	2.25	635	27112.6	46.944	-0.96	695	29926.0	46.812	-3.32
576	24343.0	46.912	2.19	636	27159.6	46.943	-1.00	696	29972.8	46.809	-3.36
577	24389.9	46.914	2.13	637	27206.5	46.942	-1.05	697	30019.6	46.805	-3.39
578	24436.8	46.916	2.07	638	27253.4	46.941	-1.09	698	30066.4	46.802	-3.43
579	24483.7	46.918	2.01	639	27300.4	46.940	-1.14	699	30113.2	46.798	-3.46
580	24530.6	46.920	1.95	640	27347.3	46.938	-1.18	700	30160.0	46.795	-3.49
581	24577.5	46.922	1.89	641	27394.3	46.937	-1.23	701	30206.8	46.791	-3.53
582	24624.5	46.924	1.83	642	27441.2	46.936	-1.27	702	30253.6	46.788	-3.56
583	24671.4	46.926	1.77	643	27488.1	46.935	-1.32	703	30300.4	46.784	-3.60
584	24718.3	46.927	1.71	644	27535.1	46.933	-1.36	704	30347.2	46.781	-3.63
585	24765.2	46.929	1.66	645	27582.0	46.932	-1.40	705	30393.9	46.777	-3.66
586	24812.2	46.931	1.60	646	27628.9	46.931	-1.45	706	30440.7	46.773	-3.70
587	24859.1	46.932	1.54	647	27675.9	46.929	-1.49	707	30487.5	46.770	-3.73
588	24906.0	46.934	1.48	648	27722.8	46.928	-1.53	708	30534.2	46.766	-3.76
589	24953.0	46.935	1.42	649	27769.7	46.926	-1.58	709	30581.0	46.762	-3.80
590	24999.9	46.937	1.37	650	27816.6	46.924	-1.62	710	30627.8	46.758	-3.83
591	25046.8	46.938	1.31	651	27863.6	46.923	-1.66	711	30674.5	46.754	-3.86
592	25093.8	46.939	1.25	652	27910.5	46.921	-1.70	712	30721.3	46.750	-3.90
593	25140.7	46.940	1.20	653	27957.4	46.919	-1.74	713	30768.0	46.747	-3.93
594	25187.7	46.942	1.14	654	28004.3	46.918	-1.79	714	30814.8	46.743	-3.96
595	25234.6	46.943	1.08	655	28051.2	46.916	-1.83	715	30861.5	46.739	-4.00
596	25281.5	46.944	1.03	656	28098.1	46.914	-1.87	716	30908.2	46.735	-4.03
597	25328.5	46.945	0.97	657	28145.1	46.912	-1.91	717	30955.0	46.731	-4.06
598	25375.4	46.946	0.92	658	28192.0	46.910	-1.95	718	31001.7	46.726	-4.10
599	25422.4	46.947	0.86	659	28238.9	46.908	-1.99	719	31048.4	46.722	-4.13
600	25469.3	46.947	0.81	660	28285.8	46.906	-2.03	720	31095.2	46.718	-4.16

TABLE 8.5.2. *Platinum, Pt-67, versus Type TN (or EN) thermoelements—thermoelectric voltages, $E(T)$, Seebeck coefficients, $S(T)$, and first derivative of the Seebeck coefficients, dS/dT , reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
720	31095.2	46.718	-4.16	780	33889.5	46.406	-6.33	840	36660.8	45.941	-9.34
721	31141.9	46.714	-4.20	781	33935.9	46.400	-6.38	841	36706.8	45.931	-9.40
722	31188.6	46.710	-4.23	782	33982.3	46.393	-6.42	842	36752.7	45.922	-9.45
723	31235.3	46.706	-4.26	783	34028.7	46.387	-6.46	843	36798.6	45.912	-9.51
724	31282.0	46.701	-4.30	784	34075.1	46.380	-6.50	844	36844.5	45.903	-9.57
725	31328.7	46.697	-4.33	785	34121.5	46.374	-6.55	845	36890.4	45.893	-9.63
726	31375.4	46.693	-4.36	786	34167.8	46.367	-6.59	846	36936.3	45.884	-9.69
727	31422.1	46.688	-4.40	787	34214.2	46.361	-6.63	847	36982.2	45.874	-9.75
728	31468.8	46.684	-4.43	788	34260.6	46.354	-6.68	848	37028.0	45.864	-9.80
729	31515.4	46.679	-4.46	789	34306.9	46.347	-6.72	849	37073.9	45.854	-9.86
730	31562.1	46.675	-4.50	790	34353.3	46.340	-6.76	850	37119.8	45.844	-9.92
731	31608.8	46.670	-4.53	791	34399.6	46.334	-6.81	851	37165.6	45.834	-9.98
732	31655.5	46.666	-4.56	792	34445.9	46.327	-6.85	852	37211.4	45.824	-10.04
733	31702.1	46.661	-4.60	793	34492.2	46.320	-6.90	853	37257.2	45.814	-10.10
734	31748.8	46.657	-4.63	794	34538.6	46.313	-6.94	854	37303.1	45.804	-10.16
735	31795.4	46.652	-4.66	795	34584.9	46.306	-6.99	855	37348.8	45.794	-10.22
736	31842.1	46.647	-4.70	796	34631.2	46.299	-7.04	856	37394.6	45.784	-10.28
737	31888.7	46.643	-4.73	797	34677.5	46.292	-7.08	857	37440.4	45.773	-10.33
738	31935.4	46.638	-4.77	798	34723.8	46.285	-7.13	858	37486.2	45.763	-10.39
739	31982.0	46.633	-4.80	799	34770.0	46.278	-7.18	859	37531.9	45.753	-10.45
740	32028.6	46.628	-4.83	800	34816.3	46.271	-7.22	860	37577.7	45.742	-10.51
741	32075.3	46.623	-4.87	801	34862.6	46.263	-7.27	861	37623.4	45.732	-10.57
742	32121.9	46.619	-4.90	802	34908.8	46.256	-7.32	862	37669.2	45.721	-10.63
743	32168.5	46.614	-4.94	803	34955.1	46.249	-7.37	863	37714.9	45.710	-10.69
744	32215.1	46.609	-4.97	804	35001.3	46.241	-7.42	864	37760.6	45.700	-10.75
745	32261.7	46.604	-5.01	805	35047.6	46.234	-7.46	865	37806.3	45.689	-10.80
746	32308.3	46.599	-5.04	806	35093.8	46.226	-7.51	866	37852.0	45.678	-10.86
747	32354.9	46.594	-5.08	807	35140.0	46.219	-7.56	867	37897.6	45.667	-10.92
748	32401.5	46.588	-5.11	808	35186.2	46.211	-7.61	868	37943.3	45.656	-10.98
749	32448.1	46.583	-5.15	809	35232.5	46.204	-7.66	869	37988.9	45.645	-11.04
750	32494.7	46.578	-5.18	810	35278.7	46.196	-7.71	870	38034.6	45.634	-11.09
751	32541.3	46.573	-5.22	811	35324.8	46.188	-7.76	871	38080.2	45.623	-11.15
752	32587.8	46.568	-5.25	812	35371.0	46.180	-7.81	872	38125.8	45.612	-11.21
753	32634.4	46.562	-5.29	813	35417.2	46.173	-7.86	873	38171.4	45.601	-11.27
754	32680.9	46.557	-5.33	814	35463.4	46.165	-7.91	874	38217.0	45.589	-11.32
755	32727.5	46.552	-5.36	815	35509.5	46.157	-7.97	875	38262.6	45.578	-11.38
756	32774.1	46.546	-5.40	816	35555.7	46.149	-8.02	876	38308.2	45.567	-11.43
757	32820.6	46.541	-5.44	817	35601.8	46.141	-8.07	877	38353.7	45.555	-11.49
758	32867.1	46.536	-5.47	818	35648.0	46.133	-8.12	878	38399.3	45.544	-11.55
759	32913.7	46.530	-5.51	819	35694.1	46.124	-8.18	879	38444.8	45.532	-11.60
760	32960.2	46.525	-5.55	820	35740.2	46.116	-8.23	880	38490.4	45.520	-11.65
761	33006.7	46.519	-5.58	821	35786.3	46.108	-8.28	881	38535.9	45.509	-11.71
762	33053.2	46.513	-5.62	822	35832.4	46.100	-8.34	882	38581.4	45.497	-11.76
763	33099.7	46.508	-5.66	823	35878.5	46.091	-8.39	883	38626.9	45.485	-11.82
764	33146.2	46.502	-5.70	824	35924.6	46.083	-8.44	884	38672.3	45.473	-11.87
765	33192.7	46.496	-5.73	825	35970.7	46.074	-8.50	885	38717.8	45.461	-11.92
766	33239.2	46.491	-5.77	826	36016.8	46.066	-8.55	886	38763.3	45.450	-11.97
767	33285.7	46.485	-5.81	827	36062.8	46.057	-8.61	887	38808.7	45.438	-12.02
768	33332.2	46.479	-5.85	828	36108.9	46.049	-8.66	888	38854.1	45.425	-12.07
769	33378.7	46.473	-5.89	829	36154.9	46.040	-8.72	889	38899.6	45.413	-12.12
770	33425.2	46.467	-5.93	830	36201.0	46.031	-8.77	890	38945.0	45.401	-12.17
771	33471.6	46.461	-5.97	831	36247.0	46.022	-8.83	891	38990.4	45.389	-12.22
772	33518.1	46.455	-6.01	832	36293.0	46.014	-8.88	892	39035.7	45.377	-12.27
773	33564.5	46.449	-6.05	833	36339.0	46.005	-8.94	893	39081.1	45.364	-12.31
774	33611.0	46.443	-6.09	834	36385.0	45.996	-9.00	894	39126.5	45.352	-12.36
775	33657.4	46.437	-6.13	835	36431.0	45.987	-9.05	895	39171.8	45.340	-12.41
776	33703.8	46.431	-6.17	836	36477.0	45.978	-9.11	896	39217.2	45.327	-12.45
777	33750.3	46.425	-6.21	837	36523.0	45.968	-9.17	897	39262.5	45.315	-12.49
778	33796.7	46.418	-6.25	838	36568.9	45.959	-9.22	898	39307.8	45.302	-12.54
779	33843.1	46.412	-6.29	839	36614.9	45.950	-9.28	899	39353.1	45.290	-12.58
780	33889.5	46.406	-6.33	840	36660.8	45.941	-9.34	900	39398.4	45.277	-12.62

TABLE 8.5.2. *Platinum, Pt-67, versus Type TN (or EN) thermoelements—thermoelectric voltages, E(T), Seebeck coefficients, S(T), and first derivative of the Seebeck coefficients, dS/dT, reference junctions at 0 °C—Continued*

T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²	T °C	E μV	S μV/°C	dS/dT nV/°C ²
900	39398.4	45.277	-12.62	935	40975.1	44.820	-13.15	970	42536.1	44.394	-10.45
901	39443.6	45.265	-12.66	936	41019.9	44.807	-13.13	971	42580.5	44.383	-10.30
902	39488.9	45.252	-12.70	937	41064.7	44.794	-13.11	972	42624.9	44.373	-10.14
903	39534.1	45.239	-12.74	938	41109.5	44.781	-13.08	973	42669.2	44.363	-9.98
904	39579.4	45.226	-12.77	939	41154.3	44.768	-13.05	974	42713.6	44.353	-9.81
905	39624.6	45.214	-12.81	940	41199.1	44.755	-13.02	975	42757.9	44.344	-9.63
906	39669.8	45.201	-12.84	941	41243.8	44.742	-12.99	976	42802.3	44.334	-9.45
907	39715.0	45.188	-12.88	942	41288.5	44.729	-12.95	977	42846.6	44.325	-9.27
908	39760.2	45.175	-12.91	943	41333.3	44.716	-12.91	978	42890.9	44.315	-9.08
909	39805.3	45.162	-12.94	944	41378.0	44.703	-12.87	979	42935.2	44.306	-8.88
910	39850.5	45.149	-12.97	945	41422.7	44.690	-12.82	980	42979.5	44.298	-8.67
911	39895.6	45.136	-13.00	946	41467.4	44.677	-12.77	981	43023.8	44.289	-8.47
912	39940.8	45.123	-13.02	947	41512.0	44.664	-12.72	982	43068.1	44.281	-8.25
913	39985.9	45.110	-13.05	948	41556.7	44.652	-12.67	983	43112.4	44.273	-8.03
914	40031.0	45.097	-13.07	949	41601.3	44.639	-12.61	984	43156.7	44.265	-7.80
915	40076.1	45.084	-13.10	950	41646.0	44.627	-12.54	985	43200.9	44.257	-7.56
916	40121.2	45.071	-13.12	951	41690.6	44.614	-12.48	986	43245.2	44.250	-7.32
917	40166.2	45.058	-13.14	952	41735.2	44.602	-12.41	987	43289.4	44.242	-7.07
918	40211.3	45.045	-13.15	953	41779.8	44.589	-12.33	988	43333.7	44.235	-6.82
919	40256.3	45.031	-13.17	954	41824.4	44.577	-12.26	989	43377.9	44.229	-6.56
920	40301.3	45.018	-13.18	955	41868.9	44.565	-12.18	990	43422.1	44.222	-6.29
921	40346.3	45.005	-13.19	956	41913.5	44.553	-12.09	991	43466.3	44.216	-6.01
922	40391.3	44.992	-13.21	957	41958.0	44.541	-12.00	992	43510.6	44.210	-5.73
923	40436.3	44.979	-13.21	958	42002.6	44.529	-11.91	993	43554.8	44.205	-5.44
924	40481.3	44.965	-13.22	959	42047.1	44.517	-11.81	994	43599.0	44.199	-5.14
925	40526.3	44.952	-13.23	960	42091.6	44.505	-11.71	995	43643.2	44.194	-4.83
926	40571.2	44.939	-13.23	961	42136.1	44.493	-11.61	996	43687.4	44.190	-4.52
927	40616.1	44.926	-13.23	962	42180.6	44.482	-11.50	997	43731.5	44.185	-4.20
928	40661.1	44.913	-13.23	963	42225.1	44.470	-11.38	998	43775.7	44.181	-3.87
929	40706.0	44.899	-13.22	964	42269.5	44.459	-11.26	999	43819.9	44.178	-3.53
930	40750.9	44.886	-13.22	965	42314.0	44.448	-11.14	1000	43864.1	44.174	-3.18
931	40795.7	44.873	-13.21	966	42358.4	44.437	-11.01				
932	40840.6	44.860	-13.20	967	42402.9	44.426	-10.88				
933	40885.5	44.846	-13.19	968	42447.3	44.415	-10.74				
934	40930.3	44.833	-13.17	969	42491.7	44.404	-10.60				
935	40975.1	44.820	-13.15	970	42536.1	44.394	-10.45				

TABLE 8.5.3. *Thermoelectric values at the fixed points for platinum, Pt-67, versus Type TN (or EN) thermoelements*

Fixed point	Temp. °C	E μV	S $\mu V/^{\circ}C$	dS/dT $nV/^{\circ}C^2$
Helium NBP	-268.935	-6276.21	1.237	491.18
Hydrogen TP	-259.340	-6244.17	5.264	376.07
Hydrogen NBP	-252.870	-6202.43	7.614	353.07
Neon TP	-248.595	-6166.69	9.099	341.41
Neon NBP	-246.048	-6142.42	9.959	333.61
Oxygen TP	-218.789	-5762.03	17.296	194.20
Nitrogen TP	-210.002	-5603.14	18.806	151.02
Nitrogen NBP	-195.802	-5322.69	20.583	104.07
Oxygen NBP	-182.962	-5050.52	21.766	82.72
Carbon Dioxide SP	-78.476	-2410.33	28.481	59.11
Mercury FP	-38.862	-1236.95	30.744	56.87
Ice point*	0.000	0.0	32.860	33.98
Ether TP	26.870	896.7	33.930	44.36
Water BP	100.000	3504.2	37.395	46.04
Benzoic TP	122.370	4352.0	38.392	43.02
Indium FP	156.634	5691.7	39.775	37.63
Tin FP	231.9681	8784.0	42.186	26.95
Bismuth FP	271.442	10469.2	43.166	22.88
Cadmium FP	321.108	12639.6	44.201	18.97
Lead FP	327.502	12922.6	44.321	18.53
Mercury BP	356.660	14222.5	44.834	16.64
Zinc FP	419.580	17073.8	45.756	12.67
Sulphur BP	444.674	18225.8	46.053	11.02
Cu-Al FP	548.23	23041.3	46.827	3.94
Antimony FP	630.74	26912.6	46.947	-0.76
Aluminum FP	660.37	28303.1	46.905	-2.05
Silver FP	961.93	42177.5	44.483	-11.50

*Junction point of different functions.

TABLE 8.5.4. *Estimated maximum errors that occur when using reduced-bit arithmetic for the power series expansion for the thermoelectric voltage of platinum, Pt-67, versus Type TN (or EN) thermoelements*

Temperature range	Degree	Estimated maximum error in microvolts				
		12 Bit	16 Bit	24 Bit	27 Bit	36 Bit
-270 to -200 °C	13	(*)	(*)	9	1	<0.01
-200 to 0 °C	13	(*)	90	0.5	0.04	<0.01
0 to 200 °C	9	4	0.3	<0.01	<0.01	<0.01
200 to 400 °C	9	20	1	<0.01	<0.01	<0.01
400 to 600 °C	9	100	4	0.03	<0.01	<0.01
600 to 800 °C	9	400	20	0.2	<0.01	<0.01
800 to 1000 °C	9	(*)	60	0.5	<0.01	<0.01

*A high-order polynomial with a low-bit machine causes extreme error.

Appendices

A1. General Introduction

The primary tables and functions presented in the main text are more precise than is often necessary. Also the form of these data is not always the most usable for many applications. The purpose of the tables included in these appendices is to present the same data in different formats to satisfy special needs. Only the standard thermocouple types are re-represented, i.e., S, R, B, E, J, K, and T. Six tables will be given for each of the primary thermocouple combinations. The six tables are:

(1) Voltage as a function of temperature, T in degrees Celsius, 0 °C reference temperature—the temperature interval is 1 degree Celsius and the voltage is expressed in millivolts rather than microvolts. The voltage data are usually given to the nearest 0.001 millivolt (the primary tables given in the text have a resolution of 0.01 microvolt wherever the experimental data would allow).

(2) Voltage as a function of temperature, T in degrees Fahrenheit, 32 °F reference temperature—these tables are similar to those discussed in (1) except that the smaller Fahrenheit degree results in a finer temperature grid.

(3) Approximation coefficients for voltage as a function of temperature, T in degrees Celsius, E in microvolts, 0 °C reference temperature—these tables present reduced order approximations of the quartic form

$$E = a_0 + a_1 T + a_2 T^2 + a_3 T^3 + a_4 T^4$$

for selected temperature ranges. Coefficients are also given for cubic and quadratic approximations. The maximum difference between E as determined with the full precision coefficients given in the text and E as determined by these approximation functions is also given for each order and temperature range.

(4) Temperature as a function of voltage, T in degrees Celsius, 0 °C reference temperature—these tables, obtained by iteration in the $E = f(T)$ data, are presented with 0.01 millivolt intervals in voltage and 0.01 degrees Celsius resolution in temperature. They are essentially the inverse tables from those described in (1) above.

(5) Temperature as a function of voltage, T in degrees Fahrenheit, 32 °F reference temperature—these tables are similar to those discussed in (4) except that the temperatures are expressed in degrees Fahrenheit. They are essentially the inverse tables from those described in (2) above.

(6) Approximation functions for temperatures as a function of voltage, T in degrees Celsius, E in microvolts—these tables present reduced order approximations similar to those described in (3) for selected temperature ranges. The maximum difference between T as determined by iteration in the full precision tables and T as determined by these approximation functions is also given for each order and temperature range.

The table numbering scheme represents the particular thermocouple combination by the first digit, e.g., A2. represents Type S, A3. represents Type R, etc. The second digit indicates whether the data are presented as a function of temperature (.1.) or a function of voltage (.2.). The third digit is just the sequence of tables for a particular material and particular functional dependence; .1. indicates degrees Celsius, .2. indicates degrees Fahrenheit, and .3. indicates approximation equations.

All the tables and approximations presented in the appendices are based on reference junctions of 0 °C (or 32 °F).

A2. Supplementary Data for Type S—Platinum—10% Rhodium Alloy Versus Platinum Thermocouples

A2.1. Data for Voltage as a Function of Temperature

The full precision coefficients given in the main text are used to generate the voltage as a function of temperature data given in tables A2.1.1. and A2.1.2. Table A2.1.1. presents the data in degrees Celsius from -50°C to 1768°C while table A2.1.2. presents the data in degrees Fahrenheit from -58°F to 3214°F . Table A2.1.3. contains quadratic, cubic, and quartic approximations to the data as a function of temperature in selected temperature ranges. The error range given in the table is the difference between the voltage as obtained from the full precision coefficients from the text and the respective reduced order approximations. The last entries in the cubic and quadratic groupings of table A2.1.3 represent variable reference junction corrections in the 0 to 50°C temperature range. In the narrower temperature range near room temperatures, 20 to 25°C , the error range for the given *quadratic* equation is smaller than that listed in the last column: $\pm 0.02\ \mu\text{V}$.

TABLE A2.1.1. *Type S thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C*

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-50	-0.2357											-50
-40	-0.1944	-0.1987	-0.2029	-0.2071	-0.2113	-0.2155	-0.2196	-0.2236	-0.2277	-0.2317	-0.2357	-40
-30	-0.1501	-0.1547	-0.1592	-0.1637	-0.1682	-0.1726	-0.1771	-0.1815	-0.1858	-0.1901	-0.1944	-30
-20	-0.1028	-0.1077	-0.1125	-0.1173	-0.1221	-0.1268	-0.1315	-0.1362	-0.1409	-0.1455	-0.1501	-20
-10	-0.0527	-0.0579	-0.0630	-0.0680	-0.0731	-0.0781	-0.0831	-0.0881	-0.0930	-0.0979	-0.1028	-10
0	0.0000	-0.0054	-0.0107	-0.0161	-0.0214	-0.0267	-0.0319	-0.0372	-0.0424	-0.0476	-0.0527	0
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A2.1.1. Type S thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C —Continued

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	0.0000	0.0054	0.0108	0.0163	0.0218	0.0273	0.0328	0.0384	0.0440	0.0496	0.0552	0
10	0.0552	0.0609	0.0666	0.0723	0.0780	0.0837	0.0895	0.0953	0.1011	0.1070	0.1128	10
20	0.1128	0.1187	0.1246	0.1305	0.1365	0.1425	0.1485	0.1545	0.1605	0.1666	0.1727	20
30	0.1727	0.1788	0.1849	0.1910	0.1972	0.2034	0.2096	0.2158	0.2221	0.2284	0.2346	30
40	0.2346	0.2410	0.2473	0.2536	0.2600	0.2664	0.2728	0.2792	0.2857	0.2922	0.2986	40
50	0.2986	0.3051	0.3117	0.3182	0.3248	0.3314	0.3380	0.3446	0.3512	0.3579	0.3645	50
60	0.3645	0.3712	0.3780	0.3847	0.3914	0.3982	0.4050	0.4118	0.4186	0.4254	0.4323	60
70	0.4323	0.4391	0.4460	0.4529	0.4598	0.4668	0.4737	0.4807	0.4877	0.4947	0.5017	70
80	0.5017	0.5087	0.5158	0.5228	0.5299	0.5370	0.5441	0.5513	0.5584	0.5656	0.5727	80
90	0.5727	0.5799	0.5871	0.5944	0.6016	0.6089	0.6161	0.6234	0.6307	0.6380	0.6453	90
100	0.6453	0.6527	0.6600	0.6674	0.6748	0.6822	0.6896	0.6970	0.7045	0.7119	0.7194	100
110	0.7194	0.7269	0.7344	0.7419	0.7494	0.7569	0.7645	0.7720	0.7796	0.7872	0.7948	110
120	0.7948	0.8024	0.8101	0.8177	0.8254	0.8330	0.8407	0.8484	0.8561	0.8638	0.8715	120
130	0.8715	0.8793	0.8870	0.8948	0.9026	0.9104	0.9182	0.9260	0.9338	0.9417	0.9495	130
140	0.9495	0.9574	0.9653	0.9731	0.9810	0.9889	0.9969	1.0048	1.0127	1.0207	1.0287	140
150	1.0287	1.0366	1.0446	1.0526	1.0606	1.0687	1.0767	1.0847	1.0928	1.1009	1.1089	150
160	1.1089	1.1170	1.1251	1.1332	1.1413	1.1495	1.1576	1.1657	1.1739	1.1821	1.1902	160
170	1.1902	1.1984	1.2066	1.2148	1.2231	1.2313	1.2395	1.2478	1.2560	1.2643	1.2726	170
180	1.2726	1.2808	1.2891	1.2974	1.3058	1.3141	1.3224	1.3308	1.3391	1.3475	1.3558	180
190	1.3558	1.3642	1.3726	1.3810	1.3894	1.3978	1.4062	1.4147	1.4231	1.4316	1.4400	190
200	1.4400	1.4485	1.4569	1.4654	1.4739	1.4824	1.4909	1.4994	1.5080	1.5165	1.5250	200
210	1.5250	1.5336	1.5421	1.5507	1.5593	1.5679	1.5765	1.5850	1.5937	1.6023	1.6109	210
220	1.6109	1.6195	1.6281	1.6368	1.6454	1.6541	1.6628	1.6714	1.6801	1.6888	1.6975	220
230	1.6975	1.7062	1.7149	1.7236	1.7324	1.7411	1.7498	1.7586	1.7673	1.7761	1.7849	230
240	1.7849	1.7936	1.8024	1.8112	1.8200	1.8288	1.8376	1.8464	1.8553	1.8641	1.8729	240
250	1.8729	1.8818	1.8906	1.8995	1.9083	1.9172	1.9261	1.9350	1.9439	1.9528	1.9617	250
260	1.9617	1.9706	1.9795	1.9884	1.9973	2.0063	2.0152	2.0242	2.0331	2.0421	2.0510	260
270	2.0510	2.0600	2.0690	2.0780	2.0870	2.0959	2.1049	2.1140	2.1230	2.1320	2.1410	270
280	2.1410	2.1500	2.1591	2.1681	2.1772	2.1862	2.1953	2.2043	2.2134	2.2225	2.2316	280
290	2.2316	2.2407	2.2497	2.2588	2.2679	2.2771	2.2862	2.2953	2.3044	2.3135	2.3227	290
300	2.3227	2.3318	2.3410	2.3501	2.3593	2.3684	2.3776	2.3868	2.3960	2.4051	2.4143	300
310	2.4143	2.4235	2.4327	2.4419	2.4511	2.4603	2.4696	2.4788	2.4880	2.4972	2.5065	310
320	2.5065	2.5157	2.5250	2.5342	2.5435	2.5527	2.5620	2.5713	2.5806	2.5898	2.5991	320
330	2.5991	2.6084	2.6177	2.6270	2.6363	2.6456	2.6549	2.6643	2.6736	2.6829	2.6922	330
340	2.6922	2.7016	2.7109	2.7203	2.7296	2.7390	2.7483	2.7577	2.7670	2.7764	2.7858	340
350	2.7858	2.7952	2.8046	2.8139	2.8233	2.8327	2.8421	2.8515	2.8609	2.8704	2.8798	350
360	2.8798	2.8892	2.8986	2.9081	2.9175	2.9269	2.9364	2.9458	2.9553	2.9647	2.9742	360
370	2.9742	2.9836	2.9931	3.0026	3.0121	3.0215	3.0310	3.0405	3.0500	3.0595	3.0690	370
380	3.0690	3.0785	3.0880	3.0975	3.1070	3.1165	3.1261	3.1356	3.1451	3.1546	3.1642	380
390	3.1642	3.1737	3.1833	3.1928	3.2024	3.2119	3.2215	3.2310	3.2406	3.2502	3.2597	390
400	3.2597	3.2693	3.2789	3.2885	3.2981	3.3076	3.3172	3.3268	3.3364	3.3460	3.3557	400
410	3.3557	3.3653	3.3749	3.3845	3.3941	3.4037	3.4134	3.4230	3.4326	3.4423	3.4519	410
420	3.4519	3.4616	3.4712	3.4809	3.4905	3.5002	3.5098	3.5195	3.5292	3.5389	3.5485	420
430	3.5485	3.5582	3.5679	3.5776	3.5873	3.5970	3.6066	3.6163	3.6261	3.6358	3.6455	430
440	3.6455	3.6552	3.6649	3.6746	3.6843	3.6941	3.7038	3.7135	3.7232	3.7330	3.7427	440
450	3.7427	3.7525	3.7622	3.7720	3.7817	3.7915	3.8012	3.8110	3.8208	3.8305	3.8403	450
460	3.8403	3.8501	3.8598	3.8696	3.8794	3.8892	3.8990	3.9088	3.9186	3.9284	3.9382	460
470	3.9382	3.9480	3.9578	3.9676	3.9774	3.9872	3.9970	4.0068	4.0167	4.0265	4.0363	470
480	4.0363	4.0462	4.0560	4.0659	4.0757	4.0856	4.0954	4.1053	4.1151	4.1250	4.1348	480
490	4.1348	4.1447	4.1546	4.1644	4.1743	4.1842	4.1941	4.2039	4.2138	4.2237	4.2336	490
500	4.2336	4.2435	4.2534	4.2633	4.2732	4.2831	4.2930	4.3029	4.3128	4.3227	4.3327	500
510	4.3327	4.3426	4.3525	4.3624	4.3724	4.3823	4.3922	4.4022	4.4121	4.4221	4.4320	510
520	4.4320	4.4419	4.4519	4.4619	4.4718	4.4818	4.4917	4.5017	4.5117	4.5217	4.5316	520
530	4.5316	4.5416	4.5516	4.5616	4.5716	4.5816	4.5915	4.6015	4.6115	4.6215	4.6316	530
540	4.6316	4.6416	4.6516	4.6616	4.6716	4.6816	4.6916	4.7017	4.7117	4.7217	4.7318	540
550	4.7318	4.7418	4.7518	4.7619	4.7719	4.7820	4.7920	4.8021	4.8121	4.8222	4.8323	550
560	4.8323	4.8423	4.8524	4.8625	4.8725	4.8826	4.8927	4.9028	4.9129	4.9230	4.9331	560
570	4.9331	4.9432	4.9533	4.9634	4.9735	4.9836	4.9937	5.0038	5.0139	5.0240	5.0342	570
580	5.0342	5.0443	5.0544	5.0646	5.0747	5.0848	5.0950	5.1051	5.1153	5.1254	5.1356	580
590	5.1356	5.1457	5.1559	5.1661	5.1762	5.1864	5.1966	5.2067	5.2169	5.2271	5.2373	590
600	5.2373	5.2475	5.2577	5.2679	5.2781	5.2883	5.2985	5.3087	5.3189	5.3291	5.3394	600
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A2.1.1. *Type S thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C—Continued*

°C	0	1	2	3	4	5	6	7	8	9	10	°C
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	5.2373	5.2475	5.2577	5.2679	5.2781	5.2883	5.2985	5.3087	5.3189	5.3291	5.3394	600
610	5.3394	5.3496	5.3598	5.3700	5.3803	5.3905	5.4007	5.4110	5.4212	5.4315	5.4417	610
620	5.4417	5.4520	5.4623	5.4725	5.4828	5.4931	5.5033	5.5136	5.5239	5.5342	5.5445	620
630	5.5445	5.5548	5.5651	5.5754	5.5857	5.5961	5.6064	5.6167	5.6271	5.6374	5.6477	630
640	5.6477	5.6581	5.6684	5.6788	5.6891	5.6995	5.7099	5.7202	5.7306	5.7410	5.7513	640
650	5.7513	5.7617	5.7721	5.7825	5.7929	5.8033	5.8137	5.8241	5.8345	5.8449	5.8553	650
660	5.8553	5.8657	5.8761	5.8865	5.8969	5.9074	5.9178	5.9282	5.9387	5.9491	5.9595	660
670	5.9595	5.9700	5.9804	5.9909	6.0013	6.0118	6.0222	6.0327	6.0432	6.0536	6.0641	670
680	6.0641	6.0746	6.0851	6.0956	6.1060	6.1165	6.1270	6.1375	6.1480	6.1585	6.1690	680
690	6.1690	6.1795	6.1901	6.2006	6.2111	6.2216	6.2321	6.2427	6.2532	6.2637	6.2743	690
700	6.2743	6.2848	6.2954	6.3059	6.3165	6.3270	6.3376	6.3482	6.3587	6.3693	6.3799	700
710	6.3799	6.3904	6.4010	6.4116	6.4222	6.4328	6.4434	6.4540	6.4646	6.4752	6.4858	710
720	6.4858	6.4964	6.5070	6.5176	6.5282	6.5388	6.5495	6.5601	6.5707	6.5814	6.5920	720
730	6.5920	6.6026	6.6133	6.6239	6.6346	6.6452	6.6559	6.6666	6.6772	6.6879	6.6986	730
740	6.6986	6.7092	6.7199	6.7306	6.7413	6.7520	6.7627	6.7734	6.7840	6.7947	6.8055	740
750	6.8055	6.8162	6.8269	6.8376	6.8483	6.8590	6.8697	6.8805	6.8912	6.9019	6.9127	750
760	6.9127	6.9234	6.9342	6.9449	6.9557	6.9664	6.9772	6.9879	6.9987	7.0095	7.0202	760
770	7.0202	7.0310	7.0418	7.0526	7.0633	7.0741	7.0849	7.0957	7.1065	7.1173	7.1281	770
780	7.1281	7.1389	7.1497	7.1605	7.1713	7.1822	7.1930	7.2038	7.2146	7.2255	7.2363	780
790	7.2363	7.2471	7.2580	7.2688	7.2797	7.2905	7.3014	7.3123	7.3231	7.3340	7.3448	790
800	7.3448	7.3557	7.3666	7.3775	7.3884	7.3992	7.4101	7.4210	7.4319	7.4428	7.4537	800
810	7.4537	7.4646	7.4755	7.4864	7.4974	7.5083	7.5192	7.5301	7.5410	7.5520	7.5629	810
820	7.5629	7.5738	7.5848	7.5957	7.6067	7.6176	7.6286	7.6395	7.6505	7.6615	7.6724	820
830	7.6724	7.6834	7.6944	7.7054	7.7163	7.7273	7.7383	7.7493	7.7603	7.7713	7.7823	830
840	7.7823	7.7933	7.8043	7.8153	7.8263	7.8373	7.8484	7.8594	7.8704	7.8814	7.8925	840
850	7.8925	7.9035	7.9145	7.9256	7.9366	7.9477	7.9587	7.9698	7.9809	7.9919	8.0030	850
860	8.0030	8.0141	8.0251	8.0362	8.0473	8.0584	8.0694	8.0805	8.0916	8.1027	8.1138	860
870	8.1138	8.1249	8.1360	8.1471	8.1583	8.1694	8.1805	8.1916	8.2027	8.2139	8.2250	870
880	8.2250	8.2361	8.2473	8.2584	8.2696	8.2807	8.2919	8.3030	8.3142	8.3253	8.3365	880
890	8.3365	8.3477	8.3588	8.3700	8.3812	8.3924	8.4035	8.4147	8.4259	8.4371	8.4483	890
900	8.4483	8.4595	8.4707	8.4819	8.4931	8.5044	8.5156	8.5268	8.5380	8.5492	8.5605	900
910	8.5605	8.5717	8.5829	8.5942	8.6054	8.6167	8.6279	8.6392	8.6504	8.6617	8.6730	910
920	8.6730	8.6842	8.6955	8.7068	8.7180	8.7293	8.7406	8.7519	8.7632	8.7745	8.7858	920
930	8.7858	8.7971	8.8084	8.8197	8.8310	8.8423	8.8536	8.8649	8.8763	8.8876	8.8989	930
940	8.8989	8.9103	8.9216	8.9329	8.9443	8.9556	8.9670	8.9783	8.9897	9.0010	9.0124	940
950	9.0124	9.0238	9.0351	9.0465	9.0579	9.0693	9.0806	9.0920	9.1034	9.1148	9.1262	950
960	9.1262	9.1376	9.1490	9.1604	9.1718	9.1832	9.1946	9.2061	9.2175	9.2289	9.2403	960
970	9.2403	9.2518	9.2632	9.2746	9.2861	9.2975	9.3090	9.3204	9.3319	9.3433	9.3548	970
980	9.3548	9.3663	9.3777	9.3892	9.4007	9.4121	9.4236	9.4351	9.4466	9.4581	9.4696	980
990	9.4696	9.4811	9.4926	9.5041	9.5156	9.5271	9.5386	9.5501	9.5616	9.5732	9.5847	990
1,000	9.5847	9.5962	9.6078	9.6193	9.6308	9.6424	9.6539	9.6655	9.6770	9.6886	9.7001	1,000
1,010	9.7001	9.7117	9.7233	9.7348	9.7464	9.7580	9.7696	9.7812	9.7927	9.8043	9.8159	1,010
1,020	9.8159	9.8275	9.8391	9.8507	9.8623	9.8739	9.8855	9.8972	9.9088	9.9204	9.9320	1,020
1,030	9.9320	9.9437	9.9553	9.9669	9.9786	9.9902	10.0019	10.0135	10.0252	10.0368	10.0485	1,030
1,040	10.0485	10.0601	10.0718	10.0835	10.0951	10.1068	10.1185	10.1302	10.1419	10.1535	10.1652	1,040
1,050	10.1652	10.1769	10.1886	10.2003	10.2120	10.2237	10.2354	10.2472	10.2589	10.2706	10.2823	1,050
1,060	10.2823	10.2940	10.3058	10.3175	10.3293	10.3410	10.3527	10.3645	10.3762	10.3880	10.3997	1,060
1,070	10.3997	10.4115	10.4233	10.4350	10.4468	10.4585	10.4703	10.4821	10.4939	10.5056	10.5174	1,070
1,080	10.5174	10.5292	10.5410	10.5528	10.5646	10.5764	10.5882	10.6000	10.6118	10.6236	10.6354	1,080
1,090	10.6354	10.6472	10.6590	10.6708	10.6826	10.6944	10.7063	10.7181	10.7299	10.7417	10.7536	1,090
1,100	10.7536	10.7654	10.7772	10.7891	10.8009	10.8127	10.8246	10.8364	10.8483	10.8601	10.8720	1,100
1,110	10.8720	10.8838	10.8957	10.9076	10.9194	10.9313	10.9432	10.9550	10.9669	10.9788	10.9906	1,110
1,120	10.9906	11.0025	11.0144	11.0263	11.0382	11.0501	11.0619	11.0738	11.0857	11.0976	11.1095	1,120
1,130	11.1095	11.1214	11.1333	11.1452	11.1571	11.1690	11.1810	11.1929	11.2048	11.2167	11.2286	1,130
1,140	11.2286	11.2405	11.2525	11.2644	11.2763	11.2882	11.3002	11.3121	11.3240	11.3360	11.3479	1,140
1,150	11.3479	11.3598	11.3718	11.3837	11.3957	11.4076	11.4196	11.4315	11.4435	11.4554	11.4674	1,150
1,160	11.4674	11.4794	11.4913	11.5033	11.5152	11.5272	11.5392	11.5511	11.5631	11.5751	11.5871	1,160
1,170	11.5871	11.5990	11.6110	11.6230	11.6350	11.6470	11.6589	11.6709	11.6829	11.6949	11.7069	1,170
1,180	11.7069	11.7189	11.7309	11.7429	11.7549	11.7669	11.7789	11.7909	11.8029	11.8149	11.8269	1,180
1,190	11.8269	11.8389	11.8509	11.8629	11.8749	11.8870	11.8990	11.9110	11.9230	11.9350	11.9471	1,190
1,200	11.9471	11.9591	11.9711	11.9831	11.9952	12.0072	12.0192	12.0312	12.0433	12.0553	12.0674	1,200
°C	0	1	2	3	4	5	6	7	8	9	10	°C

TABLE A2.1.1. Type S thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C—Continued

°C	0	1	2	3	4	5	6	7	8	9	10	°C
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,200	11.9471	11.9591	11.9711	11.9831	11.9952	12.0072	12.0192	12.0312	12.0433	12.0553	12.0674	1,200
1,210	12.0674	12.0794	12.0914	12.1035	12.1155	12.1276	12.1396	12.1516	12.1637	12.1757	12.1878	1,210
1,220	12.1878	12.1998	12.2119	12.2239	12.2360	12.2481	12.2601	12.2722	12.2842	12.2963	12.3083	1,220
1,230	12.3083	12.3204	12.3325	12.3445	12.3566	12.3687	12.3807	12.3928	12.4049	12.4170	12.4290	1,230
1,240	12.4290	12.4411	12.4532	12.4652	12.4773	12.4894	12.5015	12.5136	12.5256	12.5377	12.5498	1,240
1,250	12.5498	12.5619	12.5740	12.5861	12.5981	12.6102	12.6223	12.6344	12.6465	12.6586	12.6707	1,250
1,260	12.6707	12.6828	12.6949	12.7070	12.7191	12.7312	12.7433	12.7554	12.7675	12.7796	12.7917	1,260
1,270	12.7917	12.8038	12.8159	12.8280	12.8401	12.8522	12.8643	12.8764	12.8885	12.9006	12.9127	1,270
1,280	12.9127	12.9248	12.9369	12.9490	12.9611	12.9733	12.9854	12.9975	13.0096	13.0217	13.0338	1,280
1,290	13.0338	13.0459	13.0581	13.0702	13.0823	13.0944	13.1065	13.1186	13.1308	13.1429	13.1550	1,290
1,300	13.1550	13.1671	13.1792	13.1914	13.2035	13.2156	13.2277	13.2398	13.2520	13.2641	13.2762	1,300
1,310	13.2762	13.2883	13.3005	13.3126	13.3247	13.3369	13.3490	13.3611	13.3732	13.3854	13.3975	1,310
1,320	13.3975	13.4096	13.4217	13.4339	13.4460	13.4581	13.4703	13.4824	13.4945	13.5067	13.5188	1,320
1,330	13.5188	13.5309	13.5430	13.5552	13.5673	13.5794	13.5916	13.6037	13.6158	13.6280	13.6401	1,330
1,340	13.6401	13.6522	13.6644	13.6765	13.6886	13.7008	13.7129	13.7250	13.7372	13.7493	13.7614	1,340
1,350	13.7614	13.7736	13.7857	13.7978	13.8100	13.8221	13.8342	13.8464	13.8585	13.8706	13.8828	1,350
1,360	13.8828	13.8949	13.9070	13.9192	13.9313	13.9434	13.9556	13.9677	13.9798	13.9920	14.0041	1,360
1,370	14.0041	14.0162	14.0284	14.0405	14.0526	14.0648	14.0769	14.0890	14.1012	14.1133	14.1254	1,370
1,380	14.1254	14.1375	14.1497	14.1618	14.1739	14.1861	14.1982	14.2103	14.2224	14.2346	14.2467	1,380
1,390	14.2467	14.2588	14.2710	14.2831	14.2952	14.3073	14.3195	14.3316	14.3437	14.3558	14.3680	1,390
1,400	14.3680	14.3801	14.3922	14.4043	14.4164	14.4286	14.4407	14.4528	14.4649	14.4770	14.4892	1,400
1,410	14.4892	14.5013	14.5134	14.5255	14.5376	14.5497	14.5619	14.5740	14.5861	14.5982	14.6103	1,410
1,420	14.6103	14.6224	14.6345	14.6467	14.6588	14.6709	14.6830	14.6951	14.7072	14.7193	14.7314	1,420
1,430	14.7314	14.7435	14.7556	14.7677	14.7798	14.7919	14.8040	14.8161	14.8282	14.8403	14.8524	1,430
1,440	14.8524	14.8645	14.8766	14.8887	14.9008	14.9129	14.9250	14.9371	14.9492	14.9613	14.9734	1,440
1,450	14.9734	14.9855	14.9975	15.0096	15.0217	15.0338	15.0459	15.0580	15.0701	15.0821	15.0942	1,450
1,460	15.0942	15.1063	15.1184	15.1304	15.1425	15.1546	15.1667	15.1787	15.1908	15.2029	15.2150	1,460
1,470	15.2150	15.2270	15.2391	15.2512	15.2632	15.2753	15.2874	15.2994	15.3115	15.3235	15.3356	1,470
1,480	15.3356	15.3476	15.3597	15.3718	15.3838	15.3959	15.4079	15.4200	15.4320	15.4441	15.4561	1,480
1,490	15.4561	15.4682	15.4802	15.4922	15.5043	15.5163	15.5284	15.5404	15.5524	15.5645	15.5765	1,490
1,500	15.5765	15.5885	15.6006	15.6126	15.6246	15.6366	15.6487	15.6607	15.6727	15.6847	15.6967	1,500
1,510	15.6967	15.7088	15.7208	15.7328	15.7448	15.7568	15.7688	15.7808	15.7928	15.8048	15.8168	1,510
1,520	15.8168	15.8288	15.8408	15.8528	15.8648	15.8768	15.8888	15.9008	15.9128	15.9248	15.9368	1,520
1,530	15.9368	15.9488	15.9608	15.9727	15.9847	15.9967	16.0087	16.0206	16.0326	16.0446	16.0566	1,530
1,540	16.0566	16.0685	16.0805	16.0925	16.1044	16.1164	16.1283	16.1403	16.1523	16.1642	16.1762	1,540
1,550	16.1762	16.1881	16.2001	16.2120	16.2239	16.2359	16.2478	16.2598	16.2717	16.2836	16.2956	1,550
1,560	16.2956	16.3075	16.3194	16.3314	16.3433	16.3552	16.3671	16.3790	16.3910	16.4029	16.4148	1,560
1,570	16.4148	16.4267	16.4386	16.4505	16.4624	16.4743	16.4862	16.4981	16.5100	16.5219	16.5338	1,570
1,580	16.5338	16.5457	16.5576	16.5695	16.5813	16.5932	16.6051	16.6170	16.6289	16.6407	16.6526	1,580
1,590	16.6526	16.6645	16.6763	16.6882	16.7001	16.7119	16.7238	16.7356	16.7475	16.7593	16.7712	1,590
1,600	16.7712	16.7830	16.7949	16.8067	16.8185	16.8304	16.8422	16.8540	16.8659	16.8777	16.8895	1,600
1,610	16.8895	16.9013	16.9132	16.9250	16.9368	16.9486	16.9604	16.9722	16.9840	16.9958	17.0076	1,610
1,620	17.0076	17.0194	17.0312	17.0430	17.0548	17.0666	17.0784	17.0901	17.1019	17.1137	17.1255	1,620
1,630	17.1255	17.1372	17.1490	17.1608	17.1725	17.1843	17.1961	17.2078	17.2196	17.2313	17.2431	1,630
1,640	17.2431	17.2548	17.2665	17.2783	17.2900	17.3018	17.3135	17.3252	17.3369	17.3487	17.3604	1,640
1,650	17.3604	17.3721	17.3838	17.3955	17.4072	17.4189	17.4306	17.4423	17.4540	17.4657	17.4774	1,650
1,660	17.4774	17.4891	17.5008	17.5125	17.5242	17.5358	17.5475	17.5592	17.5708	17.5825	17.5942	1,660
1,670	17.5942	17.6058	17.6175	17.6291	17.6408	17.6524	17.6640	17.6757	17.6873	17.6989	17.7105	1,670
1,680	17.7105	17.7222	17.7338	17.7454	17.7570	17.7686	17.7801	17.7917	17.8033	17.8149	17.8264	1,680
1,690	17.8264	17.8380	17.8495	17.8611	17.8726	17.8841	17.8957	17.9072	17.9187	17.9302	17.9417	1,690
1,700	17.9417	17.9532	17.9646	17.9761	17.9876	17.9990	18.0105	18.0219	18.0333	18.0448	18.0562	1,700
1,710	18.0562	18.0676	18.0790	18.0903	18.1017	18.1131	18.1244	18.1358	18.1471	18.1584	18.1698	1,710
1,720	18.1698	18.1811	18.1924	18.2036	18.2149	18.2262	18.2374	18.2487	18.2599	18.2711	18.2823	1,720
1,730	18.2823	18.2935	18.3047	18.3158	18.3270	18.3381	18.3493	18.3604	18.3715	18.3826	18.3937	1,730
1,740	18.3937	18.4047	18.4158	18.4268	18.4379	18.4489	18.4599	18.4709	18.4818	18.4928	18.5038	1,740
1,750	18.5038	18.5147	18.5256	18.5365	18.5474	18.5583	18.5691	18.5800	18.5908	18.6016	18.6124	1,750
1,760	18.6124	18.6232	18.6339	18.6447	18.6554	18.6661	18.6768	18.6875	18.6982			1,760
°C	0	1	2	3	4	5	6	7	8	9	10	°C

TABLE A2.1.2. *Type S thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-50	-0.2177	-0.2200	-0.2223	-0.2246	-0.2268	-0.2290	-0.2313	-0.2335	-0.2357			-50
-40	-0.1944	-0.1968	-0.1992	-0.2015	-0.2039	-0.2062	-0.2085	-0.2109	-0.2132	-0.2155	-0.2177	-40
-30	-0.1702	-0.1726	-0.1751	-0.1776	-0.1800	-0.1824	-0.1848	-0.1873	-0.1897	-0.1921	-0.1944	-30
-20	-0.1450	-0.1475	-0.1501	-0.1526	-0.1552	-0.1577	-0.1602	-0.1627	-0.1652	-0.1677	-0.1702	-20
-10	-0.1189	-0.1215	-0.1242	-0.1268	-0.1294	-0.1320	-0.1346	-0.1372	-0.1398	-0.1424	-0.1450	-10
- 0	-0.0919	-0.0946	-0.0974	-0.1001	-0.1028	-0.1055	-0.1082	-0.1109	-0.1136	-0.1162	-0.1189	- 0
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A2.1.2. Type S thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	-0.0919	-0.0892	-0.0864	-0.0836	-0.0809	-0.0781	-0.0753	-0.0725	-0.0697	-0.0669	-0.0641	0
10	-0.0641	-0.0613	-0.0584	-0.0556	-0.0527	-0.0499	-0.0470	-0.0441	-0.0412	-0.0383	-0.0354	10
20	-0.0354	-0.0325	-0.0296	-0.0267	-0.0237	-0.0208	-0.0179	-0.0149	-0.0119	-0.0090	-0.0060	20
30	-0.0060	-0.0030	0.0000	0.0030	0.0060	0.0090	0.0121	0.0151	0.0181	0.0212	0.0242	30
40	0.0242	0.0273	0.0304	0.0335	0.0365	0.0396	0.0427	0.0459	0.0490	0.0521	0.0552	40
50	0.0552	0.0584	0.0615	0.0647	0.0678	0.0710	0.0742	0.0774	0.0805	0.0837	0.0869	50
60	0.0869	0.0902	0.0934	0.0966	0.0998	0.1031	0.1063	0.1096	0.1128	0.1161	0.1194	60
70	0.1194	0.1226	0.1259	0.1292	0.1325	0.1358	0.1392	0.1425	0.1458	0.1491	0.1525	70
80	0.1525	0.1558	0.1592	0.1625	0.1659	0.1693	0.1727	0.1761	0.1795	0.1829	0.1863	80
90	0.1863	0.1897	0.1931	0.1965	0.2000	0.2034	0.2068	0.2103	0.2138	0.2172	0.2207	90
100	0.2207	0.2242	0.2277	0.2312	0.2346	0.2382	0.2417	0.2452	0.2487	0.2522	0.2558	100
110	0.2558	0.2593	0.2628	0.2664	0.2700	0.2735	0.2771	0.2807	0.2843	0.2878	0.2914	110
120	0.2914	0.2950	0.2986	0.3023	0.3059	0.3095	0.3131	0.3168	0.3204	0.3241	0.3277	120
130	0.3277	0.3314	0.3350	0.3387	0.3424	0.3461	0.3497	0.3534	0.3571	0.3608	0.3645	130
140	0.3645	0.3683	0.3720	0.3757	0.3794	0.3832	0.3869	0.3907	0.3944	0.3982	0.4020	140
150	0.4020	0.4057	0.4095	0.4133	0.4171	0.4209	0.4247	0.4285	0.4323	0.4361	0.4399	150
160	0.4399	0.4437	0.4475	0.4514	0.4552	0.4591	0.4629	0.4668	0.4706	0.4745	0.4784	160
170	0.4784	0.4822	0.4861	0.4900	0.4939	0.4978	0.5017	0.5056	0.5095	0.5134	0.5173	170
180	0.5173	0.5213	0.5252	0.5291	0.5331	0.5370	0.5410	0.5449	0.5489	0.5529	0.5568	180
190	0.5568	0.5608	0.5648	0.5688	0.5727	0.5767	0.5807	0.5847	0.5887	0.5928	0.5968	190
200	0.5968	0.6008	0.6048	0.6089	0.6129	0.6169	0.6210	0.6250	0.6291	0.6331	0.6372	200
210	0.6372	0.6413	0.6453	0.6494	0.6535	0.6576	0.6617	0.6658	0.6699	0.6740	0.6781	210
220	0.6781	0.6822	0.6863	0.6904	0.6945	0.6987	0.7028	0.7069	0.7111	0.7152	0.7194	220
230	0.7194	0.7235	0.7277	0.7319	0.7360	0.7402	0.7444	0.7486	0.7527	0.7569	0.7611	230
240	0.7611	0.7653	0.7695	0.7737	0.7779	0.7821	0.7864	0.7906	0.7948	0.7990	0.8033	240
250	0.8033	0.8075	0.8118	0.8160	0.8202	0.8245	0.8288	0.8330	0.8373	0.8416	0.8458	250
260	0.8458	0.8501	0.8544	0.8587	0.8630	0.8672	0.8715	0.8758	0.8801	0.8845	0.8888	260
270	0.8888	0.8931	0.8974	0.9017	0.9061	0.9104	0.9147	0.9191	0.9234	0.9277	0.9321	270
280	0.9321	0.9364	0.9408	0.9452	0.9495	0.9539	0.9583	0.9626	0.9670	0.9714	0.9758	280
290	0.9758	0.9802	0.9846	0.9889	0.9933	0.9978	1.0022	1.0066	1.0110	1.0154	1.0198	290
300	1.0198	1.0242	1.0287	1.0331	1.0375	1.0420	1.0464	1.0509	1.0553	1.0597	1.0642	300
310	1.0642	1.0687	1.0731	1.0776	1.0821	1.0865	1.0910	1.0955	1.1000	1.1044	1.1089	310
320	1.1089	1.1134	1.1179	1.1224	1.1269	1.1314	1.1359	1.1404	1.1449	1.1495	1.1540	320
330	1.1540	1.1585	1.1630	1.1676	1.1721	1.1766	1.1812	1.1857	1.1902	1.1948	1.1993	330
340	1.1993	1.2039	1.2085	1.2130	1.2176	1.2221	1.2267	1.2313	1.2359	1.2404	1.2450	340
350	1.2450	1.2496	1.2542	1.2588	1.2634	1.2680	1.2726	1.2772	1.2818	1.2864	1.2910	350
360	1.2910	1.2956	1.3002	1.3048	1.3095	1.3141	1.3187	1.3233	1.3280	1.3326	1.3372	360
370	1.3372	1.3419	1.3465	1.3512	1.3558	1.3605	1.3651	1.3698	1.3745	1.3791	1.3838	370
380	1.3838	1.3885	1.3931	1.3978	1.4025	1.4072	1.4119	1.4165	1.4212	1.4259	1.4306	380
390	1.4306	1.4353	1.4400	1.4447	1.4494	1.4541	1.4588	1.4635	1.4683	1.4730	1.4777	390
400	1.4777	1.4824	1.4871	1.4919	1.4966	1.5013	1.5061	1.5108	1.5155	1.5203	1.5250	400
410	1.5250	1.5298	1.5345	1.5393	1.5440	1.5488	1.5536	1.5583	1.5631	1.5679	1.5726	410
420	1.5726	1.5774	1.5822	1.5870	1.5917	1.5965	1.6013	1.6061	1.6109	1.6157	1.6205	420
430	1.6205	1.6253	1.6301	1.6349	1.6397	1.6445	1.6493	1.6541	1.6589	1.6637	1.6685	430
440	1.6685	1.6734	1.6782	1.6830	1.6878	1.6927	1.6975	1.7023	1.7072	1.7120	1.7169	440
450	1.7169	1.7217	1.7265	1.7314	1.7362	1.7411	1.7460	1.7508	1.7557	1.7605	1.7654	450
460	1.7654	1.7703	1.7751	1.7800	1.7849	1.7897	1.7946	1.7995	1.8044	1.8093	1.8141	460
470	1.8141	1.8190	1.8239	1.8288	1.8337	1.8386	1.8435	1.8484	1.8533	1.8582	1.8631	470
480	1.8631	1.8680	1.8729	1.8778	1.8828	1.8877	1.8926	1.8975	1.9024	1.9074	1.9123	480
490	1.9123	1.9172	1.9221	1.9271	1.9320	1.9369	1.9419	1.9468	1.9518	1.9567	1.9617	490
500	1.9617	1.9666	1.9716	1.9765	1.9815	1.9864	1.9914	1.9963	2.0013	2.0063	2.0112	500
510	2.0112	2.0162	2.0212	2.0261	2.0311	2.0361	2.0411	2.0460	2.0510	2.0560	2.0610	510
520	2.0610	2.0660	2.0710	2.0760	2.0810	2.0860	2.0909	2.0959	2.1009	2.1059	2.1110	520
530	2.1110	2.1160	2.1210	2.1260	2.1310	2.1360	2.1410	2.1460	2.1510	2.1561	2.1611	530
540	2.1611	2.1661	2.1711	2.1762	2.1812	2.1862	2.1912	2.1963	2.2013	2.2064	2.2114	540
550	2.2114	2.2164	2.2215	2.2265	2.2316	2.2366	2.2417	2.2467	2.2518	2.2568	2.2619	550
560	2.2619	2.2669	2.2720	2.2771	2.2821	2.2872	2.2923	2.2973	2.3024	2.3075	2.3125	560
570	2.3125	2.3176	2.3227	2.3278	2.3328	2.3379	2.3430	2.3481	2.3532	2.3583	2.3634	570
580	2.3634	2.3684	2.3735	2.3786	2.3837	2.3888	2.3939	2.3990	2.4041	2.4092	2.4143	580
590	2.4143	2.4194	2.4245	2.4297	2.4348	2.4399	2.4450	2.4501	2.4552	2.4603	2.4655	590
600	2.4655	2.4706	2.4757	2.4808	2.4860	2.4911	2.4962	2.5014	2.5065	2.5116	2.5168	600

TABLE A2.1.2. Type S thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	2.4655	2.4706	2.4757	2.4808	2.4860	2.4911	2.4962	2.5014	2.5065	2.5116	2.5168	600
610	2.5168	2.5219	2.5270	2.5322	2.5373	2.5425	2.5476	2.5527	2.5579	2.5630	2.5682	610
620	2.5682	2.5733	2.5785	2.5837	2.5888	2.5940	2.5991	2.6043	2.6094	2.6146	2.6198	620
630	2.6198	2.6249	2.6301	2.6353	2.6404	2.6456	2.6508	2.6560	2.6611	2.6663	2.6715	630
640	2.6715	2.6767	2.6819	2.6870	2.6922	2.6974	2.7026	2.7078	2.7130	2.7182	2.7234	640
650	2.7234	2.7286	2.7338	2.7390	2.7442	2.7494	2.7546	2.7598	2.7650	2.7702	2.7754	650
660	2.7754	2.7806	2.7858	2.7910	2.7962	2.8014	2.8066	2.8119	2.8171	2.8223	2.8275	660
670	2.8275	2.8327	2.8380	2.8432	2.8484	2.8536	2.8589	2.8641	2.8693	2.8745	2.8798	670
680	2.8798	2.8850	2.8902	2.8955	2.9007	2.9060	2.9112	2.9164	2.9217	2.9269	2.9322	680
690	2.9322	2.9374	2.9427	2.9479	2.9532	2.9584	2.9637	2.9689	2.9742	2.9794	2.9847	690
700	2.9847	2.9900	2.9952	3.0005	3.0057	3.0110	3.0163	3.0215	3.0268	3.0321	3.0373	700
710	3.0373	3.0426	3.0479	3.0532	3.0584	3.0637	3.0690	3.0743	3.0795	3.0848	3.0901	710
720	3.0901	3.0954	3.1007	3.1060	3.1112	3.1165	3.1218	3.1271	3.1324	3.1377	3.1430	720
730	3.1430	3.1483	3.1536	3.1589	3.1642	3.1695	3.1748	3.1801	3.1854	3.1907	3.1960	730
740	3.1960	3.2013	3.2066	3.2119	3.2172	3.2225	3.2278	3.2331	3.2385	3.2438	3.2491	740
750	3.2491	3.2544	3.2597	3.2651	3.2704	3.2757	3.2810	3.2863	3.2917	3.2970	3.3023	750
760	3.3023	3.3076	3.3130	3.3183	3.3236	3.3290	3.3343	3.3396	3.3450	3.3503	3.3557	760
770	3.3557	3.3610	3.3663	3.3717	3.3770	3.3824	3.3877	3.3930	3.3984	3.4037	3.4091	770
780	3.4091	3.4144	3.4198	3.4251	3.4305	3.4359	3.4412	3.4466	3.4519	3.4573	3.4626	780
790	3.4626	3.4680	3.4734	3.4787	3.4841	3.4894	3.4948	3.5002	3.5055	3.5109	3.5163	790
800	3.5163	3.5217	3.5270	3.5324	3.5378	3.5432	3.5485	3.5539	3.5593	3.5647	3.5700	800
810	3.5700	3.5754	3.5808	3.5862	3.5916	3.5970	3.6023	3.6077	3.6131	3.6185	3.6239	810
820	3.6239	3.6293	3.6347	3.6401	3.6455	3.6509	3.6563	3.6617	3.6670	3.6724	3.6778	820
830	3.6778	3.6832	3.6887	3.6941	3.6995	3.7049	3.7103	3.7157	3.7211	3.7265	3.7319	830
840	3.7319	3.7373	3.7427	3.7481	3.7535	3.7590	3.7644	3.7698	3.7752	3.7806	3.7860	840
850	3.7860	3.7915	3.7969	3.8023	3.8077	3.8132	3.8186	3.8240	3.8294	3.8349	3.8403	850
860	3.8403	3.8457	3.8512	3.8566	3.8620	3.8675	3.8729	3.8783	3.8838	3.8892	3.8946	860
870	3.8946	3.9001	3.9055	3.9110	3.9164	3.9218	3.9273	3.9327	3.9382	3.9436	3.9491	870
880	3.9491	3.9545	3.9600	3.9654	3.9709	3.9763	3.9818	3.9872	3.9927	3.9981	4.0036	880
890	4.0036	4.0090	4.0145	4.0200	4.0254	4.0309	4.0363	4.0418	4.0473	4.0527	4.0582	890
900	4.0582	4.0637	4.0691	4.0746	4.0801	4.0856	4.0910	4.0965	4.1020	4.1074	4.1129	900
910	4.1129	4.1184	4.1239	4.1293	4.1348	4.1403	4.1458	4.1513	4.1567	4.1622	4.1677	910
920	4.1677	4.1732	4.1787	4.1842	4.1897	4.1951	4.2006	4.2061	4.2116	4.2171	4.2226	920
930	4.2226	4.2281	4.2336	4.2391	4.2446	4.2501	4.2556	4.2611	4.2666	4.2721	4.2776	930
940	4.2776	4.2831	4.2886	4.2941	4.2996	4.3051	4.3106	4.3161	4.3216	4.3271	4.3327	940
950	4.3327	4.3382	4.3437	4.3492	4.3547	4.3602	4.3657	4.3713	4.3768	4.3823	4.3878	950
960	4.3878	4.3933	4.3988	4.4044	4.4099	4.4154	4.4209	4.4265	4.4320	4.4375	4.4431	960
970	4.4431	4.4486	4.4541	4.4596	4.4652	4.4707	4.4762	4.4818	4.4873	4.4929	4.4984	970
980	4.4984	4.5039	4.5095	4.5150	4.5205	4.5261	4.5316	4.5372	4.5427	4.5483	4.5538	980
990	4.5538	4.5594	4.5649	4.5705	4.5760	4.5816	4.5871	4.5927	4.5982	4.6038	4.6093	990
1,000	4.6093	4.6149	4.6204	4.6260	4.6316	4.6371	4.6427	4.6483	4.6538	4.6594	4.6649	1,000
1,010	4.6649	4.6705	4.6761	4.6816	4.6872	4.6928	4.6983	4.7039	4.7095	4.7150	4.7206	1,010
1,020	4.7206	4.7262	4.7318	4.7373	4.7429	4.7485	4.7541	4.7597	4.7652	4.7708	4.7764	1,020
1,030	4.7764	4.7820	4.7876	4.7931	4.7987	4.8043	4.8099	4.8155	4.8211	4.8267	4.8323	1,030
1,040	4.8323	4.8379	4.8435	4.8490	4.8546	4.8602	4.8658	4.8714	4.8770	4.8826	4.8882	1,040
1,050	4.8882	4.8938	4.8994	4.9050	4.9106	4.9162	4.9218	4.9275	4.9331	4.9387	4.9443	1,050
1,060	4.9443	4.9499	4.9555	4.9611	4.9667	4.9723	4.9780	4.9836	4.9892	4.9948	5.0004	1,060
1,070	5.0004	5.0061	5.0117	5.0173	5.0229	5.0285	5.0342	5.0398	5.0454	5.0510	5.0567	1,070
1,080	5.0567	5.0623	5.0679	5.0736	5.0792	5.0848	5.0905	5.0961	5.1017	5.1074	5.1130	1,080
1,090	5.1130	5.1186	5.1243	5.1299	5.1356	5.1412	5.1469	5.1525	5.1582	5.1638	5.1694	1,090
1,100	5.1694	5.1751	5.1807	5.1864	5.1920	5.1977	5.2034	5.2090	5.2147	5.2203	5.2260	1,100
1,110	5.2260	5.2316	5.2373	5.2430	5.2486	5.2543	5.2599	5.2656	5.2713	5.2769	5.2826	1,110
1,120	5.2826	5.2883	5.2940	5.2996	5.3053	5.3110	5.3166	5.3223	5.3280	5.3337	5.3394	1,120
1,130	5.3394	5.3450	5.3507	5.3564	5.3621	5.3678	5.3734	5.3791	5.3848	5.3905	5.3962	1,130
1,140	5.3962	5.4019	5.4076	5.4133	5.4190	5.4247	5.4303	5.4360	5.4417	5.4474	5.4531	1,140
1,150	5.4531	5.4588	5.4645	5.4702	5.4759	5.4817	5.4874	5.4931	5.4988	5.5045	5.5102	1,150
1,160	5.5102	5.5159	5.5216	5.5273	5.5330	5.5388	5.5445	5.5502	5.5559	5.5617	5.5674	1,160
1,170	5.5674	5.5731	5.5789	5.5846	5.5903	5.5961	5.6018	5.6075	5.6133	5.6190	5.6248	1,170
1,180	5.6248	5.6305	5.6363	5.6420	5.6477	5.6535	5.6592	5.6650	5.6707	5.6765	5.6822	1,180
1,190	5.6822	5.6880	5.6937	5.6995	5.7053	5.7110	5.7168	5.7225	5.7283	5.7341	5.7398	1,190
1,200	5.7398	5.7456	5.7513	5.7571	5.7629	5.7686	5.7744	5.7802	5.7859	5.7917	5.7975	1,200
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A2.1.2. Type S thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F —Continued

$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,200	5.7398	5.7456	5.7513	5.7571	5.7629	5.7686	5.7744	5.7802	5.7859	5.7917	5.7975	1,200
1,210	5.7975	5.8033	5.8090	5.8148	5.8206	5.8264	5.8321	5.8379	5.8437	5.8495	5.8553	1,210
1,220	5.8553	5.8611	5.8668	5.8726	5.8784	5.8842	5.8900	5.8958	5.9016	5.9074	5.9132	1,220
1,230	5.9132	5.9189	5.9247	5.9305	5.9363	5.9421	5.9479	5.9537	5.9595	5.9653	5.9711	1,230
1,240	5.9711	5.9769	5.9827	5.9886	5.9944	6.0002	6.0060	6.0118	6.0176	6.0234	6.0292	1,240
1,250	6.0292	6.0350	6.0408	6.0467	6.0525	6.0583	6.0641	6.0699	6.0758	6.0816	6.0874	1,250
1,260	6.0874	6.0932	6.0991	6.1049	6.1107	6.1165	6.1224	6.1282	6.1340	6.1399	6.1457	1,260
1,270	6.1457	6.1515	6.1574	6.1632	6.1690	6.1749	6.1807	6.1866	6.1924	6.1982	6.2041	1,270
1,280	6.2041	6.2099	6.2158	6.2216	6.2275	6.2333	6.2392	6.2450	6.2509	6.2567	6.2626	1,280
1,290	6.2626	6.2684	6.2743	6.2801	6.2860	6.2919	6.2977	6.3036	6.3094	6.3153	6.3212	1,290
1,300	6.3212	6.3270	6.3329	6.3388	6.3446	6.3505	6.3564	6.3622	6.3681	6.3740	6.3799	1,300
1,310	6.3799	6.3857	6.3916	6.3975	6.4034	6.4092	6.4151	6.4210	6.4269	6.4328	6.4387	1,310
1,320	6.4387	6.4445	6.4504	6.4563	6.4622	6.4681	6.4740	6.4799	6.4858	6.4917	6.4976	1,320
1,330	6.4976	6.5034	6.5093	6.5152	6.5211	6.5270	6.5329	6.5388	6.5447	6.5506	6.5565	1,330
1,340	6.5565	6.5625	6.5684	6.5743	6.5802	6.5861	6.5920	6.5979	6.6038	6.6097	6.6156	1,340
1,350	6.6156	6.6216	6.6275	6.6334	6.6393	6.6452	6.6512	6.6571	6.6630	6.6689	6.6749	1,350
1,360	6.6749	6.6808	6.6867	6.6926	6.6986	6.7045	6.7104	6.7164	6.7223	6.7282	6.7342	1,360
1,370	6.7342	6.7401	6.7460	6.7520	6.7579	6.7638	6.7698	6.7757	6.7817	6.7876	6.7936	1,370
1,380	6.7936	6.7995	6.8055	6.8114	6.8173	6.8233	6.8293	6.8352	6.8412	6.8471	6.8531	1,380
1,390	6.8531	6.8590	6.8650	6.8709	6.8769	6.8829	6.8888	6.8948	6.9007	6.9067	6.9127	1,390
1,400	6.9127	6.9186	6.9246	6.9306	6.9365	6.9425	6.9485	6.9545	6.9604	6.9664	6.9724	1,400
1,410	6.9724	6.9784	6.9843	6.9903	6.9963	7.0023	7.0083	7.0142	7.0202	7.0262	7.0322	1,410
1,420	7.0322	7.0382	7.0442	7.0502	7.0561	7.0621	7.0681	7.0741	7.0801	7.0861	7.0921	1,420
1,430	7.0921	7.0981	7.1041	7.1101	7.1161	7.1221	7.1281	7.1341	7.1401	7.1461	7.1521	1,430
1,440	7.1521	7.1581	7.1641	7.1701	7.1762	7.1822	7.1882	7.1942	7.2002	7.2062	7.2122	1,440
1,450	7.2122	7.2183	7.2243	7.2303	7.2363	7.2423	7.2484	7.2544	7.2604	7.2664	7.2725	1,450
1,460	7.2725	7.2785	7.2845	7.2905	7.2966	7.3026	7.3086	7.3147	7.3207	7.3267	7.3328	1,460
1,470	7.3328	7.3388	7.3448	7.3509	7.3569	7.3630	7.3690	7.3751	7.3811	7.3871	7.3932	1,470
1,480	7.3932	7.3992	7.4053	7.4113	7.4174	7.4234	7.4295	7.4355	7.4416	7.4477	7.4537	1,480
1,490	7.4537	7.4598	7.4658	7.4719	7.4780	7.4840	7.4901	7.4961	7.5022	7.5083	7.5143	1,490
1,500	7.5143	7.5204	7.5265	7.5325	7.5386	7.5447	7.5508	7.5568	7.5629	7.5690	7.5751	1,500
1,510	7.5751	7.5811	7.5872	7.5933	7.5994	7.6055	7.6115	7.6176	7.6237	7.6298	7.6359	1,510
1,520	7.6359	7.6420	7.6481	7.6542	7.6602	7.6663	7.6724	7.6785	7.6846	7.6907	7.6968	1,520
1,530	7.6968	7.7029	7.7090	7.7151	7.7212	7.7273	7.7334	7.7395	7.7456	7.7517	7.7578	1,530
1,540	7.7578	7.7640	7.7701	7.7762	7.7823	7.7884	7.7945	7.8006	7.8067	7.8129	7.8190	1,540
1,550	7.8190	7.8251	7.8312	7.8373	7.8435	7.8496	7.8557	7.8618	7.8680	7.8741	7.8802	1,550
1,560	7.8802	7.8863	7.8925	7.8986	7.9047	7.9109	7.9170	7.9231	7.9293	7.9354	7.9415	1,560
1,570	7.9415	7.9477	7.9538	7.9600	7.9661	7.9723	7.9784	7.9845	7.9907	7.9968	8.0030	1,570
1,580	8.0030	8.0091	8.0153	8.0214	8.0276	8.0337	8.0399	8.0460	8.0522	8.0584	8.0645	1,580
1,590	8.0645	8.0707	8.0768	8.0830	8.0892	8.0953	8.1015	8.1077	8.1138	8.1200	8.1262	1,590
1,600	8.1262	8.1323	8.1385	8.1447	8.1508	8.1570	8.1632	8.1694	8.1755	8.1817	8.1879	1,600
1,610	8.1879	8.1941	8.2003	8.2064	8.2126	8.2188	8.2250	8.2312	8.2374	8.2436	8.2497	1,610
1,620	8.2497	8.2559	8.2621	8.2683	8.2745	8.2807	8.2869	8.2931	8.2993	8.3055	8.3117	1,620
1,630	8.3117	8.3179	8.3241	8.3303	8.3365	8.3427	8.3489	8.3551	8.3613	8.3675	8.3737	1,630
1,640	8.3737	8.3799	8.3862	8.3924	8.3986	8.4048	8.4110	8.4172	8.4234	8.4297	8.4359	1,640
1,650	8.4359	8.4421	8.4483	8.4545	8.4608	8.4670	8.4732	8.4794	8.4857	8.4919	8.4981	1,650
1,660	8.4981	8.5044	8.5106	8.5168	8.5231	8.5293	8.5355	8.5418	8.5480	8.5542	8.5605	1,660
1,670	8.5605	8.5667	8.5730	8.5792	8.5854	8.5917	8.5979	8.6042	8.6104	8.6167	8.6229	1,670
1,680	8.6229	8.6292	8.6354	8.6417	8.6479	8.6542	8.6604	8.6667	8.6730	8.6792	8.6855	1,680
1,690	8.6855	8.6917	8.6980	8.7043	8.7105	8.7168	8.7231	8.7293	8.7356	8.7419	8.7481	1,690
1,700	8.7481	8.7544	8.7607	8.7670	8.7732	8.7795	8.7858	8.7921	8.7983	8.8046	8.8109	1,700
1,710	8.8109	8.8172	8.8235	8.8297	8.8360	8.8423	8.8486	8.8549	8.8612	8.8675	8.8738	1,710
1,720	8.8738	8.8800	8.8863	8.8926	8.8989	8.9052	8.9115	8.9178	8.9241	8.9304	8.9367	1,720
1,730	8.9367	8.9430	8.9493	8.9556	8.9619	8.9682	8.9745	8.9808	8.9872	8.9935	8.9998	1,730
1,740	8.9998	9.0061	9.0124	9.0187	9.0250	9.0313	9.0377	9.0440	9.0503	9.0566	9.0629	1,740
1,750	9.0629	9.0693	9.0756	9.0819	9.0882	9.0946	9.1009	9.1072	9.1135	9.1199	9.1262	1,750
1,760	9.1262	9.1325	9.1389	9.1452	9.1515	9.1579	9.1642	9.1705	9.1769	9.1832	9.1896	1,760
1,770	9.1896	9.1959	9.2022	9.2086	9.2149	9.2213	9.2276	9.2340	9.2403	9.2467	9.2530	1,770
1,780	9.2530	9.2594	9.2657	9.2721	9.2784	9.2848	9.2912	9.2975	9.3039	9.3102	9.3166	1,780
1,790	9.3166	9.3230	9.3293	9.3357	9.3421	9.3484	9.3548	9.3612	9.3675	9.3739	9.3803	1,790
1,800	9.3803	9.3866	9.3930	9.3994	9.4058	9.4121	9.4185	9.4249	9.4313	9.4377	9.4440	1,800

TABLE A2.1.2. Type S thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,800	9.3803	9.3866	9.3930	9.3994	9.4058	9.4121	9.4185	9.4249	9.4313	9.4377	9.4440	1,800
1,810	9.4440	9.4504	9.4568	9.4632	9.4696	9.4760	9.4824	9.4887	9.4951	9.5015	9.5079	1,810
1,820	9.5079	9.5143	9.5207	9.5271	9.5335	9.5399	9.5463	9.5527	9.5591	9.5655	9.5719	1,820
1,830	9.5719	9.5783	9.5847	9.5911	9.5975	9.6039	9.6103	9.6167	9.6231	9.6296	9.6360	1,830
1,840	9.6360	9.6424	9.6488	9.6552	9.6616	9.6680	9.6745	9.6809	9.6873	9.6937	9.7001	1,840
1,850	9.7001	9.7066	9.7130	9.7194	9.7258	9.7323	9.7387	9.7451	9.7516	9.7580	9.7644	1,850
1,860	9.7644	9.7709	9.7773	9.7837	9.7902	9.7966	9.8030	9.8095	9.8159	9.8224	9.8288	1,860
1,870	9.8288	9.8353	9.8417	9.8481	9.8546	9.8610	9.8675	9.8739	9.8804	9.8868	9.8933	1,870
1,880	9.8933	9.8997	9.9062	9.9127	9.9191	9.9256	9.9320	9.9385	9.9450	9.9514	9.9579	1,880
1,890	9.9579	9.9643	9.9708	9.9773	9.9837	9.9902	9.9967	10.0031	10.0096	10.0161	10.0226	1,890
1,900	10.0226	10.0290	10.0355	10.0420	10.0485	10.0549	10.0614	10.0679	10.0744	10.0809	10.0873	1,900
1,910	10.0873	10.0938	10.1003	10.1068	10.1133	10.1198	10.1263	10.1328	10.1393	10.1457	10.1522	1,910
1,920	10.1522	10.1587	10.1652	10.1717	10.1782	10.1847	10.1912	10.1977	10.2042	10.2107	10.2172	1,920
1,930	10.2172	10.2237	10.2302	10.2367	10.2433	10.2498	10.2563	10.2628	10.2693	10.2758	10.2823	1,930
1,940	10.2823	10.2888	10.2954	10.3019	10.3084	10.3149	10.3214	10.3279	10.3345	10.3410	10.3475	1,940
1,950	10.3475	10.3540	10.3606	10.3671	10.3736	10.3801	10.3867	10.3932	10.3997	10.4063	10.4128	1,950
1,960	10.4128	10.4193	10.4259	10.4324	10.4389	10.4455	10.4520	10.4585	10.4651	10.4716	10.4782	1,960
1,970	10.4782	10.4847	10.4913	10.4978	10.5043	10.5109	10.5174	10.5240	10.5305	10.5371	10.5436	1,970
1,980	10.5436	10.5502	10.5567	10.5633	10.5698	10.5764	10.5829	10.5895	10.5960	10.6026	10.6091	1,980
1,990	10.6091	10.6157	10.6222	10.6288	10.6354	10.6419	10.6485	10.6550	10.6616	10.6682	10.6747	1,990
2,000	10.6747	10.6813	10.6879	10.6944	10.7010	10.7076	10.7141	10.7207	10.7273	10.7338	10.7404	2,000
2,010	10.7404	10.7470	10.7536	10.7601	10.7667	10.7733	10.7799	10.7864	10.7930	10.7996	10.8062	2,010
2,020	10.8062	10.8127	10.8193	10.8259	10.8325	10.8391	10.8456	10.8522	10.8588	10.8654	10.8720	2,020
2,030	10.8720	10.8786	10.8852	10.8917	10.8983	10.9049	10.9115	10.9181	10.9247	10.9313	10.9379	2,030
2,040	10.9379	10.9445	10.9511	10.9577	10.9643	10.9709	10.9775	10.9840	10.9906	10.9972	11.0038	2,040
2,050	11.0038	11.0104	11.0170	11.0236	11.0303	11.0369	11.0435	11.0501	11.0567	11.0633	11.0699	2,050
2,060	11.0699	11.0765	11.0831	11.0897	11.0963	11.1029	11.1095	11.1161	11.1227	11.1294	11.1360	2,060
2,070	11.1360	11.1426	11.1492	11.1558	11.1624	11.1690	11.1757	11.1823	11.1889	11.1955	11.2021	2,070
2,080	11.2021	11.2088	11.2154	11.2220	11.2286	11.2352	11.2419	11.2485	11.2551	11.2617	11.2684	2,080
2,090	11.2684	11.2750	11.2816	11.2882	11.2949	11.3015	11.3081	11.3148	11.3214	11.3280	11.3346	2,090
2,100	11.3346	11.3413	11.3479	11.3545	11.3612	11.3678	11.3744	11.3811	11.3877	11.3944	11.4010	2,100
2,110	11.4010	11.4076	11.4143	11.4209	11.4275	11.4342	11.4408	11.4475	11.4541	11.4607	11.4674	2,110
2,120	11.4674	11.4740	11.4807	11.4873	11.4940	11.5006	11.5073	11.5139	11.5206	11.5272	11.5339	2,120
2,130	11.5339	11.5405	11.5471	11.5538	11.5605	11.5671	11.5738	11.5804	11.5871	11.5937	11.6004	2,130
2,140	11.6004	11.6070	11.6137	11.6203	11.6270	11.6336	11.6403	11.6470	11.6536	11.6603	11.6669	2,140
2,150	11.6669	11.6736	11.6803	11.6869	11.6936	11.7002	11.7069	11.7136	11.7202	11.7269	11.7335	2,150
2,160	11.7335	11.7402	11.7469	11.7535	11.7602	11.7669	11.7735	11.7802	11.7869	11.7935	11.8002	2,160
2,170	11.8002	11.8069	11.8136	11.8202	11.8269	11.8336	11.8402	11.8469	11.8536	11.8603	11.8669	2,170
2,180	11.8669	11.8736	11.8803	11.8870	11.8936	11.9003	11.9070	11.9137	11.9203	11.9270	11.9337	2,180
2,190	11.9337	11.9404	11.9471	11.9537	11.9604	11.9671	11.9738	11.9805	11.9871	11.9938	12.0005	2,190
2,200	12.0005	12.0072	12.0139	12.0206	12.0272	12.0339	12.0406	12.0473	12.0540	12.0607	12.0674	2,200
2,210	12.0674	12.0740	12.0807	12.0874	12.0941	12.1008	12.1075	12.1142	12.1209	12.1276	12.1342	2,210
2,220	12.1342	12.1409	12.1476	12.1543	12.1610	12.1677	12.1744	12.1811	12.1878	12.1945	12.2012	2,220
2,230	12.2012	12.2079	12.2146	12.2213	12.2280	12.2347	12.2414	12.2481	12.2548	12.2614	12.2681	2,230
2,240	12.2681	12.2748	12.2815	12.2882	12.2949	12.3016	12.3083	12.3150	12.3218	12.3285	12.3352	2,240
2,250	12.3352	12.3419	12.3486	12.3553	12.3620	12.3687	12.3754	12.3821	12.3888	12.3955	12.4022	2,250
2,260	12.4022	12.4089	12.4156	12.4223	12.4290	12.4357	12.4424	12.4491	12.4559	12.4626	12.4693	2,260
2,270	12.4693	12.4760	12.4827	12.4894	12.4961	12.5028	12.5095	12.5162	12.5230	12.5297	12.5364	2,270
2,280	12.5364	12.5431	12.5498	12.5565	12.5632	12.5699	12.5767	12.5834	12.5901	12.5968	12.6035	2,280
2,290	12.6035	12.6102	12.6170	12.6237	12.6304	12.6371	12.6438	12.6505	12.6573	12.6640	12.6707	2,290
2,300	12.6707	12.6774	12.6841	12.6908	12.6976	12.7043	12.7110	12.7177	12.7244	12.7312	12.7379	2,300
2,310	12.7379	12.7446	12.7513	12.7580	12.7648	12.7715	12.7782	12.7849	12.7917	12.7984	12.8051	2,310
2,320	12.8051	12.8118	12.8186	12.8253	12.8320	12.8387	12.8454	12.8522	12.8589	12.8656	12.8723	2,320
2,330	12.8723	12.8791	12.8858	12.8925	12.8993	12.9060	12.9127	12.9194	12.9262	12.9329	12.9396	2,330
2,340	12.9396	12.9463	12.9531	12.9598	12.9665	12.9733	12.9800	12.9867	12.9934	13.0002	13.0069	2,340
2,350	13.0069	13.0136	13.0204	13.0271	13.0338	13.0406	13.0473	13.0540	13.0607	13.0675	13.0742	2,350
2,360	13.0742	13.0809	13.0877	13.0944	13.1011	13.1079	13.1146	13.1213	13.1281	13.1348	13.1415	2,360
2,370	13.1415	13.1483	13.1550	13.1617	13.1685	13.1752	13.1819	13.1887	13.1954	13.2021	13.2089	2,370
2,380	13.2089	13.2156	13.2223	13.2291	13.2358	13.2425	13.2493	13.2560	13.2628	13.2695	13.2762	2,380
2,390	13.2762	13.2830	13.2897	13.2964	13.3032	13.3099	13.3166	13.3234	13.3301	13.3369	13.3436	2,390
2,400	13.3436	13.3503	13.3571	13.3638	13.3705	13.3773	13.3840	13.3908	13.3975	13.4042	13.4110	2,400
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A2.1.2. Type S thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
2,400	13.3436	13.3503	13.3571	13.3638	13.3705	13.3773	13.3840	13.3908	13.3975	13.4042	13.4110	2,400
2,410	13.4110	13.4177	13.4244	13.4312	13.4379	13.4447	13.4514	13.4581	13.4649	13.4716	13.4784	2,410
2,420	13.4784	13.4851	13.4918	13.4986	13.5053	13.5120	13.5188	13.5255	13.5323	13.5390	13.5457	2,420
2,430	13.5457	13.5525	13.5592	13.5660	13.5727	13.5794	13.5862	13.5929	13.5997	13.6064	13.6131	2,430
2,440	13.6131	13.6199	13.6266	13.6334	13.6401	13.6468	13.6536	13.6603	13.6671	13.6738	13.6805	2,440
2,450	13.6805	13.6873	13.6940	13.7008	13.7075	13.7143	13.7210	13.7277	13.7345	13.7412	13.7480	2,450
2,460	13.7480	13.7547	13.7614	13.7682	13.7749	13.7817	13.7884	13.7951	13.8019	13.8086	13.8154	2,460
2,470	13.8154	13.8221	13.8288	13.8356	13.8423	13.8491	13.8558	13.8626	13.8693	13.8760	13.8828	2,470
2,480	13.8828	13.8895	13.8963	13.9030	13.9097	13.9165	13.9232	13.9300	13.9367	13.9434	13.9502	2,480
2,490	13.9502	13.9569	13.9637	13.9704	13.9771	13.9839	13.9906	13.9974	14.0041	14.0108	14.0176	2,490
2,500	14.0176	14.0243	14.0311	14.0378	14.0445	14.0513	14.0580	14.0648	14.0715	14.0782	14.0850	2,500
2,510	14.0850	14.0917	14.0985	14.1052	14.1119	14.1187	14.1254	14.1322	14.1389	14.1456	14.1524	2,510
2,520	14.1524	14.1591	14.1658	14.1726	14.1793	14.1861	14.1928	14.1995	14.2063	14.2130	14.2198	2,520
2,530	14.2198	14.2265	14.2332	14.2400	14.2467	14.2534	14.2602	14.2669	14.2736	14.2804	14.2871	2,530
2,540	14.2871	14.2939	14.3006	14.3073	14.3141	14.3208	14.3275	14.3343	14.3410	14.3477	14.3545	2,540
2,550	14.3545	14.3612	14.3680	14.3747	14.3814	14.3882	14.3949	14.4016	14.4084	14.4151	14.4218	2,550
2,560	14.4218	14.4286	14.4353	14.4420	14.4488	14.4555	14.4622	14.4690	14.4757	14.4824	14.4892	2,560
2,570	14.4892	14.4959	14.5026	14.5094	14.5161	14.5228	14.5296	14.5363	14.5430	14.5497	14.5565	2,570
2,580	14.5565	14.5632	14.5699	14.5767	14.5834	14.5901	14.5969	14.6036	14.6103	14.6170	14.6238	2,580
2,590	14.6238	14.6305	14.6372	14.6440	14.6507	14.6574	14.6641	14.6709	14.6776	14.6843	14.6911	2,590
2,600	14.6911	14.6978	14.7045	14.7112	14.7180	14.7247	14.7314	14.7381	14.7449	14.7516	14.7583	2,600
2,610	14.7583	14.7650	14.7718	14.7785	14.7852	14.7919	14.7987	14.8054	14.8121	14.8188	14.8255	2,610
2,620	14.8255	14.8323	14.8390	14.8457	14.8524	14.8591	14.8659	14.8726	14.8793	14.8860	14.8928	2,620
2,630	14.8928	14.8995	14.9062	14.9129	14.9196	14.9263	14.9331	14.9398	14.9465	14.9532	14.9599	2,630
2,640	14.9599	14.9666	14.9734	14.9801	14.9868	14.9935	15.0002	15.0069	15.0137	15.0204	15.0271	2,640
2,650	15.0271	15.0338	15.0405	15.0472	15.0539	15.0607	15.0674	15.0741	15.0808	15.0875	15.0942	2,650
2,660	15.0942	15.1009	15.1076	15.1143	15.1211	15.1278	15.1345	15.1412	15.1479	15.1546	15.1613	2,660
2,670	15.1613	15.1680	15.1747	15.1814	15.1881	15.1948	15.2015	15.2083	15.2150	15.2217	15.2284	2,670
2,680	15.2284	15.2351	15.2418	15.2485	15.2552	15.2619	15.2686	15.2753	15.2820	15.2887	15.2954	2,680
2,690	15.2954	15.3021	15.3088	15.3155	15.3222	15.3289	15.3356	15.3423	15.3490	15.3557	15.3624	2,690
2,700	15.3624	15.3691	15.3758	15.3825	15.3892	15.3959	15.4026	15.4093	15.4159	15.4226	15.4293	2,700
2,710	15.4293	15.4360	15.4427	15.4494	15.4561	15.4628	15.4695	15.4762	15.4829	15.4896	15.4963	2,710
2,720	15.4963	15.5029	15.5096	15.5163	15.5230	15.5297	15.5364	15.5431	15.5498	15.5564	15.5631	2,720
2,730	15.5631	15.5698	15.5765	15.5832	15.5899	15.5965	15.6032	15.6099	15.6166	15.6233	15.6300	2,730
2,740	15.6300	15.6366	15.6433	15.6500	15.6567	15.6634	15.6700	15.6767	15.6834	15.6901	15.6967	2,740
2,750	15.6967	15.7034	15.7101	15.7168	15.7234	15.7301	15.7368	15.7435	15.7501	15.7568	15.7635	2,750
2,760	15.7635	15.7702	15.7768	15.7835	15.7902	15.7968	15.8035	15.8102	15.8168	15.8235	15.8302	2,760
2,770	15.8302	15.8368	15.8435	15.8502	15.8568	15.8635	15.8702	15.8768	15.8835	15.8902	15.8968	2,770
2,780	15.8968	15.9035	15.9101	15.9168	15.9235	15.9301	15.9368	15.9434	15.9501	15.9568	15.9634	2,780
2,790	15.9634	15.9701	15.9767	15.9834	15.9900	15.9967	16.0033	16.0100	16.0167	16.0233	16.0300	2,790
2,800	16.0300	16.0366	16.0433	16.0499	16.0566	16.0632	16.0699	16.0765	16.0832	16.0898	16.0964	2,800
2,810	16.0964	16.1031	16.1097	16.1164	16.1230	16.1297	16.1363	16.1430	16.1496	16.1562	16.1629	2,810
2,820	16.1629	16.1695	16.1762	16.1828	16.1894	16.1961	16.2027	16.2093	16.2160	16.2226	16.2293	2,820
2,830	16.2293	16.2359	16.2425	16.2492	16.2558	16.2624	16.2691	16.2757	16.2823	16.2889	16.2956	2,830
2,840	16.2956	16.3022	16.3088	16.3155	16.3221	16.3287	16.3353	16.3420	16.3486	16.3552	16.3618	2,840
2,850	16.3618	16.3685	16.3751	16.3817	16.3883	16.3949	16.4016	16.4082	16.4148	16.4214	16.4280	2,850
2,860	16.4280	16.4346	16.4413	16.4479	16.4545	16.4611	16.4677	16.4743	16.4809	16.4875	16.4942	2,860
2,870	16.4942	16.5008	16.5074	16.5140	16.5206	16.5272	16.5338	16.5404	16.5470	16.5536	16.5602	2,870
2,880	16.5602	16.5668	16.5734	16.5800	16.5866	16.5932	16.5998	16.6064	16.6130	16.6196	16.6262	2,880
2,890	16.6262	16.6328	16.6394	16.6460	16.6526	16.6592	16.6658	16.6724	16.6790	16.6856	16.6922	2,890
2,900	16.6922	16.6987	16.7053	16.7119	16.7185	16.7251	16.7317	16.7383	16.7448	16.7514	16.7580	2,900
2,910	16.7580	16.7646	16.7712	16.7778	16.7843	16.7909	16.7975	16.8041	16.8107	16.8172	16.8238	2,910
2,920	16.8238	16.8304	16.8370	16.8435	16.8501	16.8567	16.8632	16.8698	16.8764	16.8830	16.8895	2,920
2,930	16.8895	16.8961	16.9027	16.9092	16.9158	16.9224	16.9289	16.9355	16.9420	16.9486	16.9552	2,930
2,940	16.9552	16.9617	16.9683	16.9748	16.9814	16.9880	16.9945	17.0011	17.0076	17.0142	17.0207	2,940
2,950	17.0207	17.0273	17.0338	17.0404	17.0469	17.0535	17.0600	17.0666	17.0731	17.0797	17.0862	2,950
2,960	17.0862	17.0928	17.0993	17.1059	17.1124	17.1189	17.1255	17.1320	17.1386	17.1451	17.1516	2,960
2,970	17.1516	17.1582	17.1647	17.1712	17.1778	17.1843	17.1908	17.1974	17.2039	17.2104	17.2170	2,970
2,980	17.2170	17.2235	17.2300	17.2365	17.2431	17.2496	17.2561	17.2626	17.2692	17.2757	17.2822	2,980
2,990	17.2822	17.2887	17.2952	17.3018	17.3083	17.3148	17.3213	17.3278	17.3343	17.3408	17.3474	2,990
3,000	17.3474	17.3539	17.3604	17.3669	17.3734	17.3799	17.3864	17.3929	17.3994	17.4059	17.4124	3,000
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A2.1.2. *Type S thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
3,000	17.3474	17.3539	17.3604	17.3669	17.3734	17.3799	17.3864	17.3929	17.3994	17.4059	17.4124	3,000
3,010	17.4124	17.4189	17.4254	17.4319	17.4384	17.4449	17.4514	17.4579	17.4644	17.4709	17.4774	3,010
3,020	17.4774	17.4839	17.4904	17.4969	17.5034	17.5099	17.5164	17.5229	17.5293	17.5358	17.5423	3,020
3,030	17.5423	17.5488	17.5553	17.5618	17.5682	17.5747	17.5812	17.5877	17.5942	17.6006	17.6071	3,030
3,040	17.6071	17.6136	17.6201	17.6265	17.6330	17.6395	17.6459	17.6524	17.6589	17.6653	17.6718	3,040
3,050	17.6718	17.6783	17.6847	17.6912	17.6976	17.7041	17.7105	17.7170	17.7234	17.7299	17.7363	3,050
3,060	17.7363	17.7428	17.7492	17.7557	17.7621	17.7686	17.7750	17.7814	17.7879	17.7943	17.8007	3,060
3,070	17.8007	17.8072	17.8136	17.8200	17.8264	17.8329	17.8393	17.8457	17.8521	17.8585	17.8649	3,070
3,080	17.8649	17.8713	17.8777	17.8841	17.8905	17.8969	17.9033	17.9097	17.9161	17.9225	17.9289	3,080
3,090	17.9289	17.9353	17.9417	17.9481	17.9544	17.9608	17.9672	17.9736	17.9799	17.9863	17.9927	3,090
3,100	17.9927	17.9990	18.0054	18.0117	18.0181	18.0245	18.0308	18.0371	18.0435	18.0498	18.0562	3,100
3,110	18.0562	18.0625	18.0688	18.0752	18.0815	18.0878	18.0941	18.1005	18.1068	18.1131	18.1194	3,110
3,120	18.1194	18.1257	18.1320	18.1383	18.1446	18.1509	18.1572	18.1635	18.1698	18.1760	18.1823	3,120
3,130	18.1823	18.1886	18.1949	18.2011	18.2074	18.2137	18.2199	18.2262	18.2324	18.2387	18.2449	3,130
3,140	18.2449	18.2512	18.2574	18.2636	18.2699	18.2761	18.2823	18.2885	18.2947	18.3010	18.3072	3,140
3,150	18.3072	18.3134	18.3196	18.3258	18.3320	18.3381	18.3443	18.3505	18.3567	18.3629	18.3690	3,150
3,160	18.3690	18.3752	18.3814	18.3875	18.3937	18.3998	18.4060	18.4121	18.4183	18.4244	18.4305	3,160
3,170	18.4305	18.4366	18.4428	18.4489	18.4550	18.4611	18.4672	18.4733	18.4794	18.4855	18.4916	3,170
3,180	18.4916	18.4977	18.5038	18.5098	18.5159	18.5220	18.5280	18.5341	18.5401	18.5462	18.5522	3,180
3,190	18.5522	18.5583	18.5643	18.5703	18.5763	18.5824	18.5884	18.5944	18.6004	18.6064	18.6124	3,190
3,200	18.6124	18.6184	18.6244	18.6303	18.6363	18.6423	18.6482	18.6542	18.6602	18.6661	18.6721	3,200
3,210	18.6721	18.6780	18.6839	18.6899	18.6958							3,210
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A2.1.3. *Type S thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature (°C) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius*

Temperature Range (°C)	a_0		a_1		a_2		a_3		a_4		Error Range (μV)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
- 50 to 900	.....	..	5.5439639	+0	1.0103667	-2	-1.0944499	-5	4.9628963	-9	-7 to 14
0 to 1100	.....	..	5.8791282	+0	7.9098118	-3	-6.7450002	-6	2.5247577	-9	-16 to 12
0 to 1400	.....	..	6.2516859	+0	5.8347856	-3	-3.4351369	-6	9.4022202	-10	-35 to 25
0 to 1650	.....	..	6.5554932	+0	4.4519908	-3	-1.6378513	-6	2.4140360	-10	-55 to 35
0 to 1768	.....	..	6.6834421	+0	3.9334084	-3	-1.0384046	-6	3.4244511	-11	-60 to 35
400 to 1100	-3.8051591	+2	8.7228147	+0	6.2984807	-4	9.0526670	-7	-2.9241601	-10	-7 to .5
400 to 1400	-5.2412524	+2	9.5827994	+0	-1.2077351	-3	2.5723104	-6	-8.3681057	-10	-1.6 to 1.5
400 to 1650	-5.0061921	+2	9.4591354	+0	-9.7986687	-4	2.3967559	-6	-7.8867971	-10	-1.8 to 1.9
1050 to 1400	1.4352322	+3	2.9873073	+0	6.9951678	-3	-1.8986036	-6	6.5006637	-11	-.05 to .05
1050 to 1650	1.3054176	+3	3.4129348	+0	6.4741403	-3	-1.6163524	-6	7.9103746	-12	-.05 to .05
1400 to 1550	1.8695088	+2	6.4091373	+0	3.4664812	-3	-2.7553724	-7	-2.1606150	-10	-.05 to .05
1400 to 1650	1.0863331	+3	3.9952876	+0	5.8939317	-3	-1.3595782	-6	-3.4675031	-11	-.05 to .05
1400 to 1768	-7.4180405	+4	2.0043202	+2	-1.8607781	-1	8.1899566	-5	-1.3556030	-8	-1.0 to 1.3
1666 to 1768	8.2703440	+4	-1.3532278	+2	8.0243878	-2	-1.0633404	-5	-1.7212343	-9	-.05 to .05
II. Cubic Equation											
- 50 to 900	.....	..	6.1727088	+0	5.7640155	-3	-2.4622638	-6	.....	..	-30 to 60
0 to 1100	.....	..	6.5318477	+0	4.4314159	-3	-1.3617466	-6	.....	..	-51 to 31
0 to 1400	.....	..	6.7532549	+0	3.7355199	-3	-8.8324648	-7	.....	..	-70 to 35
0 to 1650	.....	..	6.7665573	+0	3.7028557	-3	-8.6548628	-7	.....	..	-70 to 35
0 to 1768	.....	..	6.7203042	+0	3.8113477	-3	-9.2098883	-7	.....	..	-65 to 35
400 to 1100	-3.0763512	+2	8.2834531	+0	1.5802448	-3	2.8242989	-8	.....	..	-.8 to 1.0
400 to 1400	-1.3792205	+2	7.5202132	+0	2.6472719	-3	-4.3957897	-7	.....	..	-6 to 10
400 to 1650	6.2024804	+1	6.6930160	+0	3.6814923	-3	-8.3654340	-7	.....	..	-16 to 17
1050 to 1400	1.2918771	+3	3.4602987	+0	6.4119568	-3	-1.5800960	-6	.....	..	-.05 to .05
1050 to 1650	1.2804330	+3	3.4888591	+0	6.3883551	-3	-1.5736364	-6	.....	..	-.05 to .05
1400 to 1550	1.2058568	+3	3.6416331	+0	6.2841184	-3	-1.5499505	-6	.....	..	-.05 to .05
1400 to 1650	1.2722747	+3	3.5056963	+0	6.3768029	-3	-1.5710024	-6	.....	..	-.05 to .05
1400 to 1768	9.9067391	+3	-1.3424041	+1	1.7418790	-2	-3.9666469	-6	.....	..	-2 to 4
1666 to 1768	9.7633500	+4	-1.7012950	+2	1.1066893	-1	-2.2451634	-5	.....	..	-.05 to .05
Variable reference junction correction											
0 to 50	.....	..	5.3994446	+0	1.2467754	-2	-1.9934168	-5	.....	..	-0.01 to +0.01
III. Quadratic Equation											
- 50 to 900	.....	..	7.0208414	+0	2.7110736	-3	.....	..	.....	..	-90 to 110
0 to 1100	.....	..	7.2387148	+0	2.3629498	-3	.....	..	.....	..	-110 to 50
0 to 1400	.....	..	7.4959163	+0	2.0280528	-3	.....	..	.....	..	-140 to 70
0 to 1650	.....	..	7.7773856	+0	1.7310445	-3	.....	..	.....	..	-190 to 130
0 to 1768	.....	..	7.9553026	+0	1.5630968	-3	.....	..	.....	..	-260 to 180
400 to 1100	-2.9751812	+2	8.2381836	+0	1.6438011	-3	.....	..	.....	..	-1.1 to 1.2
400 to 1400	-3.8977488	+2	8.5122920	+0	1.4602609	-3	.....	..	.....	..	-22 to 19
400 to 1650	-6.0634145	+2	9.1029993	+0	1.1089823	-3	.....	..	.....	..	-80 to 60
1050 to 1400	-1.5719586	+3	1.0540713	+1	6.0483629	-4	.....	..	.....	..	-2.6 to 2.7
1050 to 1650	-2.4585270	+3	1.1994364	+1	1.5127873	-5	.....	..	.....	..	-13 to 13
1400 to 1550	-3.7608363	+3	1.3754357	+1	-5.7526222	-4	.....	..	.....	..	-.2 to .2
1400 to 1650	-4.2764947	+3	1.4453542	+1	-8.1196867	-4	.....	..	.....	..	-.9 to 1.0
1400 to 1768	-5.7168249	+3	1.6348865	+1	-1.4335467	-3	.....	..	.....	..	-9 to 7
1666 to 1768	-1.5978814	+4	2.8439331	+1	-4.9916234	-3	.....	..	.....	..	-.9 to 1.0
Variable reference junction correction											
0 to 50	.....	..	5.4231535	+0	1.0940881	-2	.....	..	.....	..	-0.1 to +0.2

A2.2. Data for Temperature as a Function of Voltage

The temperature as a function of voltage data given in tables A2.2.1 and A2.2.2 were obtained by iteration in the primary equations for voltage as a function of temperature. Table A2.2.1 presents the data in millivolts from -0.23 mV to 18.69 mV with temperatures given in degrees Celsius while table A2.2.2 presents similar data with temperatures in degrees Fahrenheit. Table A2.2.3 contains quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges. The error range given in the table represents the difference between the temperature found by iteration in the full precision tables from the text and from the respective reduced order approximations.

TABLE A2.2.1. *Type S thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
-0.20	-41.30	-43.68	-46.10	-48.57								-0.20
-0.10	-19.43	-21.48	-23.57	-25.68	-27.81	-29.98	-32.18	-34.41	-36.67	-38.97	-41.30	-0.10
-0.00	0.00	-1.86	-3.74	-5.63	-7.54	-9.47	-11.42	-13.39	-15.38	-17.39	-19.43	-0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A2.2.1. *Type S thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (1PTS 1968)												
0.00	0.00	1.84	3.67	5.49	7.29	9.07	10.84	12.60	14.35	16.09	17.81	0.00
0.10	17.81	19.52	21.22	22.91	24.59	26.25	27.91	29.56	31.20	32.83	34.45	0.10
0.20	34.45	36.06	37.67	39.26	40.85	42.43	44.00	45.56	47.12	48.67	50.21	0.20
0.30	50.21	51.74	53.27	54.79	56.31	57.82	59.32	60.81	62.30	63.79	65.27	0.30
0.40	65.27	66.74	68.21	69.67	71.13	72.58	74.02	75.46	76.90	78.33	79.76	0.40
0.50	79.76	81.18	82.60	84.01	85.42	86.82	88.22	89.62	91.01	92.40	93.78	0.50
0.60	93.78	95.16	96.53	97.90	99.27	100.64	102.00	103.35	104.71	106.05	107.40	0.60
0.70	107.40	108.74	110.08	111.42	112.75	114.08	115.41	116.73	118.05	119.37	120.68	0.70
0.80	120.68	121.99	123.30	124.61	125.91	127.21	128.51	129.80	131.09	132.38	133.67	0.80
0.90	133.67	134.95	136.23	137.51	138.79	140.06	141.33	142.60	143.87	145.13	146.39	0.90
1.00	146.39	147.65	148.91	150.17	151.42	152.67	153.92	155.17	156.41	157.65	158.89	1.00
1.10	158.89	160.13	161.37	162.60	163.84	165.07	166.30	167.52	168.75	169.97	171.19	1.10
1.20	171.19	172.41	173.63	174.84	176.06	177.27	178.48	179.69	180.90	182.10	183.31	1.20
1.30	183.31	184.51	185.71	186.91	188.11	189.30	190.50	191.69	192.88	194.07	195.26	1.30
1.40	195.26	196.45	197.63	198.82	200.00	201.18	202.36	203.54	204.72	205.89	207.07	1.40
1.50	207.07	208.24	209.41	210.58	211.75	212.92	214.08	215.25	216.41	217.58	218.74	1.50
1.60	218.74	219.90	221.06	222.21	223.37	224.53	225.68	226.83	227.99	229.14	230.29	1.60
1.70	230.29	231.44	232.58	233.73	234.87	236.02	237.16	238.30	239.44	240.58	241.72	1.70
1.80	241.72	242.86	244.00	245.13	246.27	247.40	248.54	249.67	250.80	251.93	253.06	1.80
1.90	253.06	254.19	255.31	256.44	257.57	258.69	259.81	260.94	262.06	263.18	264.30	1.90
2.00	264.30	265.42	266.54	267.65	268.77	269.89	271.00	272.11	273.23	274.34	275.45	2.00
2.10	275.45	276.56	277.67	278.78	279.89	281.00	282.10	283.21	284.31	285.42	286.52	2.10
2.20	286.52	287.62	288.73	289.83	290.93	292.03	293.13	294.23	295.32	296.42	297.52	2.20
2.30	297.52	298.61	299.71	300.80	301.89	302.99	304.08	305.17	306.26	307.35	308.44	2.30
2.40	308.44	309.53	310.62	311.70	312.79	313.88	314.96	316.05	317.13	318.22	319.30	2.40
2.50	319.30	320.38	321.46	322.54	323.62	324.70	325.78	326.86	327.94	329.02	330.09	2.50
2.60	330.09	331.17	332.25	333.32	334.40	335.47	336.54	337.62	338.69	339.76	340.83	2.60
2.70	340.83	341.90	342.97	344.04	345.11	346.18	347.25	348.32	349.38	350.45	351.51	2.70
2.80	351.51	352.58	353.65	354.71	355.77	356.84	357.90	358.96	360.02	361.08	362.15	2.80
2.90	362.15	363.21	364.27	365.33	366.38	367.44	368.50	369.56	370.62	371.67	372.73	2.90
3.00	372.73	373.78	374.84	375.89	376.95	378.00	379.05	380.11	381.16	382.21	383.26	3.00
3.10	383.26	384.31	385.36	386.41	387.46	388.51	389.56	390.61	391.66	392.71	393.75	3.10
3.20	393.75	394.80	395.85	396.89	397.94	398.98	400.03	401.07	402.12	403.16	404.20	3.20
3.30	404.20	405.25	406.29	407.33	408.37	409.41	410.45	411.49	412.53	413.57	414.61	3.30
3.40	414.61	415.65	416.69	417.73	418.76	419.80	420.84	421.87	422.91	423.95	424.98	3.40
3.50	424.98	426.02	427.05	428.08	429.12	430.15	431.19	432.22	433.25	434.28	435.31	3.50
3.60	435.31	436.35	437.38	438.41	439.44	440.47	441.50	442.53	443.55	444.58	445.61	3.60
3.70	445.61	446.64	447.67	448.69	449.72	450.75	451.77	452.80	453.82	454.85	455.87	3.70
3.80	455.87	456.90	457.92	458.95	459.97	460.99	462.02	463.04	464.06	465.08	466.10	3.80
3.90	466.10	467.13	468.15	469.17	470.19	471.21	472.23	473.25	474.26	475.28	476.30	3.90
4.00	476.30	477.32	478.34	479.35	480.37	481.39	482.40	483.42	484.44	485.45	486.47	4.00
4.10	486.47	487.48	488.50	489.51	490.52	491.54	492.55	493.56	494.58	495.59	496.60	4.10
4.20	496.60	497.61	498.63	499.64	500.65	501.66	502.67	503.68	504.69	505.70	506.71	4.20
4.30	506.71	507.72	508.72	509.73	510.74	511.75	512.76	513.76	514.77	515.78	516.78	4.30
4.40	516.78	517.79	518.79	519.80	520.80	521.81	522.81	523.82	524.82	525.83	526.83	4.40
4.50	526.83	527.83	528.83	529.84	530.84	531.84	532.84	533.84	534.84	535.84	536.85	4.50
4.60	536.85	537.85	538.85	539.84	540.84	541.84	542.84	543.84	544.84	545.84	546.83	4.60
4.70	546.83	547.83	548.83	549.82	550.82	551.82	552.81	553.81	554.80	555.80	556.79	4.70
4.80	556.79	557.79	558.78	559.77	560.77	561.76	562.75	563.75	564.74	565.73	566.72	4.80
4.90	566.72	567.71	568.71	569.70	570.69	571.68	572.67	573.66	574.65	575.64	576.62	4.90
5.00	576.62	577.61	578.60	579.59	580.58	581.56	582.55	583.54	584.52	585.51	586.50	5.00
5.10	586.50	587.48	588.47	589.45	590.44	591.42	592.40	593.39	594.37	595.35	596.34	5.10
5.20	596.34	597.32	598.30	599.28	600.27	601.25	602.23	603.21	604.19	605.17	606.15	5.20
5.30	606.15	607.13	608.11	609.09	610.06	611.04	612.02	613.00	613.97	614.95	615.93	5.30
5.40	615.93	616.90	617.88	618.86	619.83	620.81	621.78	622.75	623.73	624.70	625.67	5.40
5.50	625.67	626.65	627.62	628.59	629.56	630.54	631.51	632.48	633.44	634.41	635.38	5.50
5.60	635.38	636.35	637.32	638.28	639.25	640.22	641.18	642.15	643.12	644.08	645.05	5.60
5.70	645.05	646.01	646.98	647.94	648.91	649.87	650.83	651.80	652.76	653.72	654.69	5.70
5.80	654.69	655.65	656.61	657.57	658.53	659.49	660.45	661.41	662.37	663.33	664.29	5.80
5.90	664.29	665.25	666.21	667.17	668.13	669.09	670.04	671.00	671.96	672.92	673.87	5.90
6.00	673.87	674.83	675.79	676.74	677.70	678.65	679.61	680.56	681.52	682.47	683.42	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A2.2.1. *Type S thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
6.00	673.87	674.83	675.79	676.74	677.70	678.65	679.61	680.56	681.52	682.47	683.42	6.00
6.10	683.42	684.38	685.33	686.28	687.24	688.19	689.14	690.09	691.04	691.99	692.95	6.10
6.20	692.95	693.90	694.85	695.80	696.75	697.70	698.64	699.59	700.54	701.49	702.44	6.20
6.30	702.44	703.39	704.33	705.28	706.23	707.17	708.12	709.07	710.01	710.96	711.90	6.30
6.40	711.90	712.85	713.79	714.74	715.68	716.63	717.57	718.51	719.46	720.40	721.34	6.40
6.50	721.34	722.28	723.23	724.17	725.11	726.05	726.99	727.93	728.87	729.81	730.75	6.50
6.60	730.75	731.69	732.63	733.57	734.51	735.45	736.39	737.32	738.26	739.20	740.13	6.60
6.70	740.13	741.07	742.01	742.94	743.88	744.82	745.75	746.69	747.62	748.56	749.49	6.70
6.80	749.49	750.42	751.36	752.29	753.23	754.16	755.09	756.02	756.96	757.89	758.82	6.80
6.90	758.82	759.75	760.68	761.61	762.54	763.47	764.40	765.33	766.26	767.19	768.12	6.90
7.00	768.12	769.05	769.98	770.91	771.84	772.76	773.69	774.62	775.54	776.47	777.40	7.00
7.10	777.40	778.32	779.25	780.18	781.10	782.03	782.95	783.88	784.80	785.72	786.65	7.10
7.20	786.65	787.57	788.49	789.42	790.34	791.26	792.19	793.11	794.03	794.95	795.87	7.20
7.30	795.87	796.79	797.71	798.63	799.55	800.47	801.39	802.31	803.23	804.15	805.07	7.30
7.40	805.07	805.99	806.91	807.82	808.74	809.66	810.58	811.49	812.41	813.33	814.24	7.40
7.50	814.24	815.16	816.07	816.99	817.90	818.82	819.73	820.65	821.56	822.48	823.39	7.50
7.60	823.39	824.30	825.22	826.13	827.04	827.95	828.87	829.78	830.69	831.60	832.51	7.60
7.70	832.51	833.42	834.33	835.24	836.15	837.06	837.97	838.88	839.79	840.70	841.61	7.70
7.80	841.61	842.52	843.43	844.33	845.24	846.15	847.06	847.96	848.87	849.78	850.68	7.80
7.90	850.68	851.59	852.49	853.40	854.30	855.21	856.11	857.02	857.92	858.83	859.73	7.90
8.00	859.73	860.63	861.54	862.44	863.34	864.25	865.15	866.05	866.96	867.85	868.75	8.00
8.10	868.75	869.66	870.56	871.46	872.36	873.26	874.16	875.06	875.96	876.86	877.75	8.10
8.20	877.75	878.65	879.55	880.45	881.35	882.25	883.14	884.04	884.94	885.83	886.73	8.20
8.30	886.73	887.63	888.52	889.42	890.31	891.21	892.10	893.00	893.89	894.79	895.68	8.30
8.40	895.68	896.58	897.47	898.36	899.26	900.15	901.04	901.94	902.83	903.72	904.61	8.40
8.50	904.61	905.50	906.39	907.29	908.18	909.07	909.96	910.85	911.74	912.63	913.52	8.50
8.60	913.52	914.41	915.30	916.18	917.07	917.96	918.85	919.74	920.62	921.51	922.40	8.60
8.70	922.40	923.29	924.17	925.06	925.95	926.83	927.72	928.60	929.49	930.37	931.26	8.70
8.80	931.26	932.14	933.03	933.91	934.80	935.68	936.56	937.45	938.33	939.21	940.10	8.80
8.90	940.10	940.98	941.86	942.74	943.62	944.50	945.39	946.27	947.15	948.03	948.91	8.90
9.00	948.91	949.79	950.67	951.55	952.43	953.31	954.19	955.07	955.94	956.82	957.70	9.00
9.10	957.70	958.58	959.46	960.33	961.21	962.09	962.96	963.84	964.72	965.59	966.47	9.10
9.20	966.47	967.35	968.22	969.10	969.97	970.85	971.72	972.59	973.47	974.34	975.22	9.20
9.30	975.22	976.09	976.96	977.84	978.71	979.58	980.45	981.33	982.20	983.07	983.94	9.30
9.40	983.94	984.81	985.68	986.56	987.43	988.30	989.17	990.04	990.91	991.78	992.65	9.40
9.50	992.65	993.51	994.38	995.25	996.12	996.99	997.86	998.72	999.59	1000.46	1001.33	9.50
9.60	1001.33	1002.19	1003.06	1003.93	1004.79	1005.66	1006.53	1007.39	1008.26	1009.12	1009.99	9.60
9.70	1009.99	1010.85	1011.72	1012.58	1013.45	1014.31	1015.17	1016.04	1016.90	1017.76	1018.63	9.70
9.80	1018.63	1019.49	1020.35	1021.21	1022.08	1022.94	1023.80	1024.66	1025.52	1026.38	1027.24	9.80
9.90	1027.24	1028.10	1028.97	1029.83	1030.69	1031.55	1032.40	1033.26	1034.12	1034.98	1035.84	9.90
10.00	1035.84	1036.70	1037.56	1038.42	1039.27	1040.13	1040.99	1041.85	1042.70	1043.56	1044.42	10.00
10.10	1044.42	1045.27	1046.13	1046.99	1047.84	1048.70	1049.55	1050.41	1051.26	1052.12	1052.97	10.10
10.20	1052.97	1053.83	1054.68	1055.54	1056.39	1057.24	1058.10	1058.95	1059.80	1060.65	1061.51	10.20
10.30	1061.51	1062.36	1063.21	1064.06	1064.92	1065.77	1066.62	1067.47	1068.32	1069.17	1070.02	10.30
10.40	1070.02	1070.87	1071.72	1072.57	1073.42	1074.27	1075.12	1075.97	1076.82	1077.67	1078.52	10.40
10.50	1078.52	1079.37	1080.22	1081.07	1081.92	1082.76	1083.61	1084.46	1085.31	1086.16	1087.00	10.50
10.60	1087.00	1087.85	1088.70	1089.55	1090.39	1091.24	1092.09	1092.93	1093.78	1094.63	1095.47	10.60
10.70	1095.47	1096.32	1097.16	1098.01	1098.85	1099.70	1100.54	1101.39	1102.23	1103.08	1103.92	10.70
10.80	1103.92	1104.77	1105.61	1106.46	1107.30	1108.14	1108.99	1109.83	1110.68	1111.52	1112.36	10.80
10.90	1112.36	1113.21	1114.05	1114.89	1115.73	1116.58	1117.42	1118.26	1119.10	1119.95	1120.79	10.90
11.00	1120.79	1121.63	1122.47	1123.31	1124.15	1124.99	1125.84	1126.68	1127.52	1128.36	1129.20	11.00
11.10	1129.20	1130.04	1130.88	1131.72	1132.56	1133.40	1134.24	1135.08	1135.92	1136.76	1137.60	11.10
11.20	1137.60	1138.44	1139.28	1140.12	1140.95	1141.79	1142.63	1143.47	1144.31	1145.15	1145.99	11.20
11.30	1145.99	1146.82	1147.66	1148.50	1149.34	1150.18	1151.01	1151.85	1152.69	1153.52	1154.36	11.30
11.40	1154.36	1155.20	1156.04	1156.87	1157.71	1158.55	1159.38	1160.22	1161.05	1161.89	1162.73	11.40
11.50	1162.73	1163.56	1164.40	1165.23	1166.07	1166.90	1167.74	1168.58	1169.41	1170.25	1171.08	11.50
11.60	1171.08	1171.92	1172.75	1173.58	1174.42	1175.25	1176.09	1176.92	1177.76	1178.59	1179.42	11.60
11.70	1179.42	1180.26	1181.09	1181.93	1182.76	1183.59	1184.43	1185.26	1186.09	1186.93	1187.76	11.70
11.80	1187.76	1188.59	1189.43	1190.26	1191.09	1191.92	1192.76	1193.59	1194.42	1195.25	1196.09	11.80
11.90	1196.09	1196.92	1197.75	1198.58	1199.41	1200.25	1201.08	1201.91	1202.74	1203.57	1204.40	11.90
12.00	1204.40	1205.23	1206.07	1206.90	1207.73	1208.56	1209.39	1210.22	1211.05	1211.88	1212.71	12.00

TABLE A2.2.1. *Type S thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (1PTS 1968)												
12.00	1204.40	1205.23	1206.07	1206.90	1207.73	1208.56	1209.39	1210.22	1211.05	1211.88	1212.71	12.00
12.10	1212.71	1213.54	1214.37	1215.20	1216.03	1216.86	1217.69	1218.52	1219.35	1220.18	1221.01	12.10
12.20	1221.01	1221.84	1222.67	1223.50	1224.33	1225.16	1225.99	1226.82	1227.65	1228.48	1229.31	12.20
12.30	1229.31	1230.14	1230.97	1231.79	1232.62	1233.45	1234.28	1235.11	1235.94	1236.77	1237.60	12.30
12.40	1237.60	1238.42	1239.25	1240.08	1240.91	1241.74	1242.57	1243.39	1244.22	1245.05	1245.88	12.40
12.50	1245.88	1246.71	1247.53	1248.36	1249.19	1250.02	1250.84	1251.67	1252.50	1253.33	1254.15	12.50
12.60	1254.15	1254.98	1255.81	1256.63	1257.46	1258.29	1259.12	1259.94	1260.77	1261.60	1262.42	12.60
12.70	1262.42	1263.25	1264.08	1264.90	1265.73	1266.56	1267.38	1268.21	1269.04	1269.86	1270.69	12.70
12.80	1270.69	1271.52	1272.34	1273.17	1273.99	1274.82	1275.65	1276.47	1277.30	1278.12	1278.95	12.80
12.90	1278.95	1279.78	1280.60	1281.43	1282.25	1283.08	1283.91	1284.73	1285.56	1286.38	1287.21	12.90
13.00	1287.21	1288.03	1288.86	1289.68	1290.51	1291.34	1292.16	1292.99	1293.81	1294.64	1295.46	13.00
13.10	1295.46	1296.29	1297.11	1297.94	1298.76	1299.59	1300.41	1301.24	1302.06	1302.89	1303.71	13.10
13.20	1303.71	1304.54	1305.36	1306.19	1307.01	1307.84	1308.66	1309.49	1310.31	1311.14	1311.96	13.20
13.30	1311.96	1312.79	1313.61	1314.44	1315.26	1316.08	1316.91	1317.73	1318.56	1319.38	1320.21	13.30
13.40	1320.21	1321.03	1321.86	1322.68	1323.50	1324.33	1325.15	1325.98	1326.80	1327.63	1328.45	13.40
13.50	1328.45	1329.28	1330.10	1330.92	1331.75	1332.57	1333.40	1334.22	1335.05	1335.87	1336.69	13.50
13.60	1336.69	1337.52	1338.34	1339.17	1339.99	1340.82	1341.64	1342.46	1343.29	1344.11	1344.94	13.60
13.70	1344.94	1345.76	1346.58	1347.41	1348.23	1349.06	1349.88	1350.71	1351.53	1352.35	1353.18	13.70
13.80	1353.18	1354.00	1354.83	1355.65	1356.47	1357.30	1358.12	1358.95	1359.77	1360.60	1361.42	13.80
13.90	1361.42	1362.24	1363.07	1363.89	1364.72	1365.54	1366.37	1367.19	1368.01	1368.84	1369.66	13.90
14.00	1369.66	1370.49	1371.31	1372.13	1372.96	1373.78	1374.61	1375.43	1376.26	1377.08	1377.90	14.00
14.10	1377.90	1378.73	1379.55	1380.38	1381.20	1382.03	1382.85	1383.68	1384.50	1385.32	1386.15	14.10
14.20	1386.15	1386.97	1387.80	1388.62	1389.45	1390.27	1391.10	1391.92	1392.75	1393.57	1394.40	14.20
14.30	1394.40	1395.22	1396.04	1396.87	1397.69	1398.52	1399.34	1400.17	1400.99	1401.82	1402.64	14.30
14.40	1402.64	1403.47	1404.29	1405.12	1405.94	1406.77	1407.59	1408.42	1409.24	1410.07	1410.89	14.40
14.50	1410.89	1411.72	1412.54	1413.37	1414.20	1415.02	1415.85	1416.67	1417.50	1418.32	1419.15	14.50
14.60	1419.15	1419.97	1420.80	1421.63	1422.45	1423.28	1424.10	1424.93	1425.75	1426.58	1427.41	14.60
14.70	1427.41	1428.23	1429.06	1429.88	1430.71	1431.54	1432.36	1433.19	1434.01	1434.84	1435.67	14.70
14.80	1435.67	1436.49	1437.32	1438.15	1438.97	1439.80	1440.63	1441.45	1442.28	1443.11	1443.93	14.80
14.90	1443.93	1444.76	1445.59	1446.41	1447.24	1448.07	1448.89	1449.72	1450.55	1451.38	1452.20	14.90
15.00	1452.20	1453.03	1453.86	1454.69	1455.51	1456.34	1457.17	1458.00	1458.82	1459.65	1460.48	15.00
15.10	1460.48	1461.31	1462.14	1462.96	1463.79	1464.62	1465.45	1466.28	1467.10	1467.93	1468.76	15.10
15.20	1468.76	1469.59	1470.42	1471.25	1472.08	1472.90	1473.73	1474.56	1475.39	1476.22	1477.05	15.20
15.30	1477.05	1477.88	1478.71	1479.54	1480.37	1481.20	1482.02	1482.85	1483.68	1484.51	1485.34	15.30
15.40	1485.34	1486.17	1487.00	1487.83	1488.66	1489.49	1490.32	1491.15	1491.98	1492.81	1493.64	15.40
15.50	1493.64	1494.48	1495.31	1496.14	1496.97	1497.80	1498.63	1499.46	1500.29	1501.12	1501.95	15.50
15.60	1501.95	1502.79	1503.62	1504.45	1505.28	1506.11	1506.94	1507.78	1508.61	1509.44	1510.27	15.60
15.70	1510.27	1511.10	1511.94	1512.77	1513.60	1514.43	1515.27	1516.10	1516.93	1517.76	1518.60	15.70
15.80	1518.60	1519.43	1520.26	1521.10	1521.93	1522.76	1523.60	1524.43	1525.26	1526.10	1526.93	15.80
15.90	1526.93	1527.77	1528.60	1529.43	1530.27	1531.10	1531.94	1532.77	1533.61	1534.44	1535.28	15.90
16.00	1535.28	1536.11	1536.95	1537.78	1538.62	1539.45	1540.29	1541.12	1541.96	1542.79	1543.63	16.00
16.10	1543.63	1544.47	1545.30	1546.14	1546.98	1547.81	1548.65	1549.48	1550.32	1551.16	1552.00	16.10
16.20	1552.00	1552.83	1553.67	1554.51	1555.34	1556.18	1557.02	1557.86	1558.70	1559.53	1560.37	16.20
16.30	1560.37	1561.21	1562.05	1562.89	1563.72	1564.56	1565.40	1566.24	1567.08	1567.92	1568.76	16.30
16.40	1568.76	1569.60	1570.44	1571.28	1572.12	1572.96	1573.80	1574.64	1575.48	1576.32	1577.16	16.40
16.50	1577.16	1578.00	1578.84	1579.68	1580.52	1581.36	1582.20	1583.04	1583.89	1584.73	1585.57	16.50
16.60	1585.57	1586.41	1587.25	1588.10	1588.94	1589.78	1590.62	1591.47	1592.31	1593.15	1593.99	16.60
16.70	1593.99	1594.84	1595.68	1596.52	1597.37	1598.21	1599.06	1599.90	1600.74	1601.59	1602.43	16.70
16.80	1602.43	1603.28	1604.12	1604.97	1605.81	1606.66	1607.50	1608.35	1609.19	1610.04	1610.89	16.80
16.90	1610.89	1611.73	1612.58	1613.42	1614.27	1615.12	1615.96	1616.81	1617.66	1618.51	1619.35	16.90
17.00	1619.35	1620.20	1621.05	1621.90	1622.75	1623.59	1624.44	1625.29	1626.14	1626.99	1627.84	17.00
17.10	1627.84	1628.69	1629.54	1630.38	1631.23	1632.08	1632.93	1633.78	1634.63	1635.48	1636.34	17.10
17.20	1636.34	1637.19	1638.04	1638.89	1639.74	1640.59	1641.44	1642.29	1643.15	1644.00	1644.85	17.20
17.30	1644.85	1645.70	1646.56	1647.41	1648.26	1649.11	1649.97	1650.82	1651.67	1652.53	1653.38	17.30
17.40	1653.38	1654.24	1655.09	1655.95	1656.80	1657.66	1658.51	1659.37	1660.22	1661.08	1661.93	17.40
17.50	1661.93	1662.79	1663.64	1664.50	1665.36	1666.21	1667.07	1667.93	1668.79	1669.64	1670.50	17.50
17.60	1670.50	1671.36	1672.22	1673.08	1673.93	1674.79	1675.65	1676.51	1677.37	1678.23	1679.09	17.60
17.70	1679.09	1679.95	1680.81	1681.68	1682.54	1683.40	1684.26	1685.12	1685.99	1686.85	1687.71	17.70
17.80	1687.71	1688.58	1689.44	1690.31	1691.17	1692.04	1692.91	1693.77	1694.64	1695.51	1696.38	17.80
17.90	1696.38	1697.24	1698.11	1698.98	1699.85	1700.72	1701.60	1702.47	1703.34	1704.21	1705.08	17.90
18.00	1705.08	1705.96	1706.83	1707.71	1708.58	1709.46	1710.34	1711.21	1712.09	1712.97	1713.85	18.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A2.2.1. *Type S thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPITS 1968)												
18.00	1705.08	1705.96	1706.83	1707.71	1708.58	1709.46	1710.34	1711.21	1712.09	1712.97	1713.85	18.00
18.10	1713.85	1714.73	1715.61	1716.49	1717.37	1718.25	1719.14	1720.02	1720.91	1721.79	1722.68	18.10
18.20	1722.68	1723.56	1724.45	1725.34	1726.23	1727.12	1728.01	1728.90	1729.79	1730.69	1731.58	18.20
18.30	1731.58	1732.48	1733.37	1734.27	1735.17	1736.06	1736.96	1737.86	1738.77	1739.67	1740.57	18.30
18.40	1740.57	1741.47	1742.38	1743.29	1744.19	1745.10	1746.01	1746.92	1747.83	1748.74	1749.66	18.40
18.50	1749.66	1750.57	1751.49	1752.40	1753.32	1754.24	1755.16	1756.08	1757.00	1757.93	1758.85	18.50
18.60	1758.85	1759.78	1760.71	1761.64	1762.57	1763.50	1764.43	1765.36	1766.30	1767.24		18.60
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A2.2.2. *Type S thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
-0.20	-42.35	-46.63	-50.99	-55.43								-0.20
-0.10	-2.97	-6.67	-10.42	-14.22	-18.07	-21.96	-25.92	-29.93	-34.00	-38.14	-42.35	-0.10
-0.00	32.00	28.65	25.27	21.87	18.43	14.95	11.44	7.90	4.32	0.70	-2.97	-0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A2.2.2. *Type S thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
0.00	32.00	35.32	38.61	41.88	45.12	48.33	51.52	54.69	57.83	60.95	64.05	0.00
0.10	64.05	67.13	70.19	73.23	76.26	79.26	82.24	85.21	88.16	91.09	94.01	0.10
0.20	94.01	96.91	99.80	102.67	105.53	108.37	111.20	114.01	116.81	119.60	122.38	0.20
0.30	122.38	125.14	127.89	130.63	133.35	136.07	138.77	141.47	144.15	146.82	149.48	0.30
0.40	149.48	152.13	154.77	157.41	160.03	162.64	165.24	167.84	170.42	173.00	175.57	0.40
0.50	175.57	178.13	180.68	183.22	185.75	188.28	190.80	193.31	195.82	198.31	200.80	0.50
0.60	200.80	203.28	205.76	208.23	210.69	213.14	215.59	218.03	220.47	222.90	225.32	0.60
0.70	225.32	227.74	230.15	232.55	234.95	237.35	239.73	242.11	244.49	246.86	249.23	0.70
0.80	249.23	251.59	253.94	256.29	258.64	260.98	263.31	265.64	267.97	270.29	272.60	0.80
0.90	272.60	274.91	277.22	279.52	281.82	284.11	286.40	288.68	290.96	293.24	295.51	0.90
1.00	295.51	297.78	300.04	302.30	304.56	306.81	309.06	311.30	313.54	315.78	318.01	1.00
1.10	318.01	320.24	322.46	324.69	326.91	329.12	331.33	333.54	335.74	337.95	340.14	1.10
1.20	340.14	342.34	344.53	346.72	348.91	351.09	353.27	355.44	357.62	359.79	361.95	1.20
1.30	361.95	364.12	366.28	368.44	370.59	372.75	374.90	377.04	379.19	381.33	383.47	1.30
1.40	383.47	385.60	387.74	389.87	392.00	394.12	396.25	398.37	400.49	402.60	404.72	1.40
1.50	404.72	406.83	408.94	411.04	413.15	415.25	417.35	419.45	421.54	423.64	425.73	1.50
1.60	425.73	427.82	429.90	431.99	434.07	436.15	438.23	440.30	442.37	444.45	446.52	1.60
1.70	446.52	448.58	450.65	452.71	454.77	456.83	458.89	460.95	463.00	465.05	467.10	1.70
1.80	467.10	469.15	471.20	473.24	475.29	477.33	479.37	481.40	483.44	485.47	487.51	1.80
1.90	487.51	489.54	491.57	493.59	495.62	497.64	499.66	501.68	503.70	505.72	507.74	1.90
2.00	507.74	509.75	511.75	513.78	515.78	517.79	519.80	521.80	523.81	525.81	527.81	2.00
2.10	527.81	529.81	531.81	533.80	535.80	537.79	539.78	541.77	543.76	545.75	547.74	2.10
2.20	547.74	549.72	551.71	553.69	555.67	557.65	559.63	561.61	563.58	565.56	567.53	2.20
2.30	567.53	569.50	571.47	573.44	575.41	577.38	579.34	581.31	583.27	585.23	587.19	2.30
2.40	587.19	589.15	591.11	593.07	595.02	596.98	598.93	600.89	602.84	604.79	606.74	2.40
2.50	606.74	608.68	610.63	612.58	614.52	616.47	618.41	620.35	622.29	624.23	626.17	2.50
2.60	626.17	628.11	630.04	631.98	633.91	635.85	637.78	639.71	641.64	643.57	645.50	2.60
2.70	645.50	647.42	649.35	651.28	653.20	655.12	657.05	658.97	660.89	662.81	664.73	2.70
2.80	664.73	666.64	668.56	670.48	672.39	674.31	676.22	678.13	680.04	681.95	683.86	2.80
2.90	683.86	685.77	687.68	689.59	691.49	693.40	695.30	697.20	699.11	701.01	702.91	2.90
3.00	702.91	704.81	706.71	708.61	710.50	712.40	714.30	716.19	718.09	719.98	721.87	3.00
3.10	721.87	723.77	725.66	727.55	729.44	731.32	733.21	735.10	736.99	738.87	740.76	3.10
3.20	740.76	742.64	744.52	746.41	748.29	750.17	752.05	753.93	755.81	757.69	759.56	3.20
3.30	759.56	761.44	763.32	765.19	767.07	768.94	770.81	772.69	774.56	776.43	778.30	3.30
3.40	778.30	780.17	782.04	783.91	785.77	787.64	789.51	791.37	793.24	795.10	796.97	3.40
3.50	796.97	798.83	800.69	802.55	804.41	806.27	808.13	809.99	811.85	813.71	815.57	3.50
3.60	815.57	817.42	819.28	821.13	822.99	824.84	826.69	828.55	830.40	832.25	834.10	3.60
3.70	834.10	835.95	837.80	839.65	841.50	843.34	845.19	847.04	848.88	850.73	852.57	3.70
3.80	852.57	854.42	856.26	858.10	859.95	861.79	863.63	865.47	867.31	869.15	870.99	3.80
3.90	870.99	872.83	874.66	876.50	878.34	880.17	882.01	883.84	885.68	887.51	889.34	3.90
4.00	889.34	891.17	893.01	894.84	896.67	898.50	900.33	902.16	903.99	905.81	907.64	4.00
4.10	907.64	909.47	911.29	913.12	914.94	916.77	918.59	920.42	922.24	924.06	925.88	4.10
4.20	925.88	927.71	929.53	931.35	933.17	934.98	936.80	938.62	940.44	942.26	944.07	4.20
4.30	944.07	945.89	947.70	949.52	951.33	953.15	954.96	956.77	958.59	960.40	962.21	4.30
4.40	962.21	964.02	965.83	967.64	969.45	971.26	973.06	974.87	976.68	978.49	980.29	4.40
4.50	980.29	982.10	983.90	985.71	987.51	989.31	991.12	992.92	994.72	996.52	998.32	4.50
4.60	998.32	1000.12	1001.92	1003.72	1005.52	1007.32	1009.12	1010.91	1012.71	1014.50	1016.30	4.60
4.70	1016.30	1018.10	1019.89	1021.68	1023.48	1025.27	1027.06	1028.85	1030.65	1032.44	1034.23	4.70
4.80	1034.23	1036.02	1037.81	1039.59	1041.38	1043.17	1044.96	1046.74	1048.53	1050.32	1052.10	4.80
4.90	1052.10	1053.89	1055.67	1057.45	1059.24	1061.02	1062.80	1064.58	1066.36	1068.14	1069.92	4.90
5.00	1069.92	1071.70	1073.48	1075.26	1077.04	1078.81	1080.59	1082.37	1084.14	1085.92	1087.69	5.00
5.10	1087.69	1089.47	1091.24	1093.01	1094.78	1096.56	1098.33	1100.10	1101.87	1103.64	1105.41	5.10
5.20	1105.41	1107.18	1108.94	1110.71	1112.48	1114.24	1116.01	1117.77	1119.54	1121.30	1123.07	5.20
5.30	1123.07	1124.83	1126.59	1128.35	1130.11	1131.87	1133.64	1135.39	1137.15	1138.91	1140.67	5.30
5.40	1140.67	1142.43	1144.18	1145.94	1147.69	1149.45	1151.20	1152.96	1154.71	1156.46	1158.21	5.40
5.50	1158.21	1159.97	1161.72	1163.47	1165.22	1166.97	1168.71	1170.46	1172.20	1173.94	1175.69	5.50
5.60	1175.69	1177.43	1179.17	1180.91	1182.65	1184.39	1186.13	1187.87	1189.61	1191.35	1193.09	5.60
5.70	1193.09	1194.82	1196.56	1198.30	1200.03	1201.77	1203.50	1205.24	1206.97	1208.70	1210.43	5.70
5.80	1210.43	1212.17	1213.90	1215.63	1217.36	1219.09	1220.82	1222.55	1224.27	1226.00	1227.73	5.80
5.90	1227.73	1229.46	1231.18	1232.91	1234.63	1236.36	1238.08	1239.80	1241.53	1243.25	1244.97	5.90
6.00	1244.97	1246.69	1248.41	1250.13	1251.85	1253.57	1255.29	1257.01	1258.73	1260.45	1262.16	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A2.2.2. *Type S thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
6.00	1244.97	1246.69	1248.41	1250.13	1251.85	1253.57	1255.29	1257.01	1258.73	1260.45	1262.16	6.00
6.10	1262.16	1263.88	1265.59	1267.31	1269.02	1270.74	1272.45	1274.16	1275.88	1277.59	1279.30	6.10
6.20	1279.30	1281.01	1282.72	1284.43	1286.14	1287.85	1289.56	1291.27	1292.98	1294.68	1296.39	6.20
6.30	1296.39	1298.10	1299.80	1301.51	1303.21	1304.91	1306.62	1308.32	1310.02	1311.73	1313.43	6.30
6.40	1313.43	1315.13	1316.83	1318.53	1320.23	1321.93	1323.63	1325.32	1327.02	1328.72	1330.42	6.40
6.50	1330.42	1332.11	1333.81	1335.50	1337.20	1338.89	1340.58	1342.28	1343.97	1345.66	1347.35	6.50
6.60	1347.35	1349.04	1350.74	1352.43	1354.12	1355.80	1357.49	1359.18	1360.87	1362.56	1364.24	6.60
6.70	1364.24	1365.93	1367.61	1369.30	1370.98	1372.67	1374.35	1376.04	1377.72	1379.40	1381.08	6.70
6.80	1381.08	1382.76	1384.45	1386.13	1387.81	1389.49	1391.16	1392.84	1394.52	1396.20	1397.88	6.80
6.90	1397.88	1399.55	1401.23	1402.90	1404.58	1406.25	1407.93	1409.60	1411.27	1412.95	1414.62	6.90
7.00	1414.62	1416.29	1417.96	1419.63	1421.30	1422.97	1424.64	1426.31	1427.98	1429.65	1431.32	7.00
7.10	1431.32	1432.98	1434.65	1436.32	1437.98	1439.65	1441.31	1442.98	1444.64	1446.30	1447.97	7.10
7.20	1447.97	1449.63	1451.29	1452.95	1454.61	1456.27	1457.93	1459.59	1461.25	1462.91	1464.57	7.20
7.30	1464.57	1466.23	1467.88	1469.54	1471.20	1472.85	1474.51	1476.16	1477.82	1479.47	1481.13	7.30
7.40	1481.13	1482.78	1484.43	1486.08	1487.74	1489.39	1491.04	1492.69	1494.34	1495.99	1497.64	7.40
7.50	1497.64	1499.29	1500.93	1502.58	1504.23	1505.87	1507.52	1509.17	1510.81	1512.46	1514.10	7.50
7.60	1514.10	1515.75	1517.39	1519.03	1520.68	1522.32	1523.96	1525.60	1527.24	1528.88	1530.52	7.60
7.70	1530.52	1532.16	1533.80	1535.44	1537.08	1538.72	1540.35	1541.99	1543.63	1545.26	1546.90	7.70
7.80	1546.90	1548.53	1550.17	1551.80	1553.43	1555.07	1556.70	1558.33	1559.97	1561.60	1563.23	7.80
7.90	1563.23	1564.86	1566.49	1568.12	1569.75	1571.38	1573.01	1574.63	1576.26	1577.89	1579.52	7.90
8.00	1579.52	1581.14	1582.77	1584.39	1586.02	1587.64	1589.27	1590.89	1592.51	1594.14	1595.76	8.00
8.10	1595.76	1597.38	1599.00	1600.62	1602.24	1603.86	1605.48	1607.10	1608.72	1610.34	1611.96	8.10
8.20	1611.96	1613.58	1615.19	1616.81	1618.43	1620.04	1621.66	1623.27	1624.89	1626.50	1628.11	8.20
8.30	1628.11	1629.73	1631.34	1632.95	1634.57	1636.18	1637.79	1639.40	1641.01	1642.62	1644.23	8.30
8.40	1644.23	1645.84	1647.45	1649.05	1650.66	1652.27	1653.88	1655.48	1657.09	1658.70	1660.30	8.40
8.50	1660.30	1661.91	1663.51	1665.11	1666.72	1668.32	1669.92	1671.53	1673.13	1674.73	1676.33	8.50
8.60	1676.33	1677.93	1679.53	1681.13	1682.73	1684.33	1685.93	1687.53	1689.12	1690.72	1692.32	8.60
8.70	1692.32	1693.92	1695.51	1697.11	1698.70	1700.30	1701.89	1703.49	1705.08	1706.67	1708.27	8.70
8.80	1708.27	1709.86	1711.45	1713.04	1714.63	1716.22	1717.81	1719.40	1720.99	1722.58	1724.17	8.80
8.90	1724.17	1725.76	1727.35	1728.93	1730.52	1732.11	1733.70	1735.28	1736.87	1738.45	1740.04	8.90
9.00	1740.04	1741.62	1743.20	1744.79	1746.37	1747.95	1749.54	1751.12	1752.70	1754.28	1755.86	9.00
9.10	1755.86	1757.44	1759.02	1760.60	1762.18	1763.76	1765.34	1766.91	1768.49	1770.07	1771.65	9.10
9.20	1771.65	1773.22	1774.80	1776.37	1777.95	1779.52	1781.10	1782.67	1784.24	1785.82	1787.39	9.20
9.30	1787.39	1788.96	1790.53	1792.11	1793.68	1795.25	1796.82	1798.39	1799.96	1801.53	1803.10	9.30
9.40	1803.10	1804.66	1806.23	1807.80	1809.37	1810.93	1812.50	1814.07	1815.63	1817.20	1818.76	9.40
9.50	1818.76	1820.33	1821.89	1823.45	1825.02	1826.58	1828.14	1829.70	1831.27	1832.83	1834.39	9.50
9.60	1834.39	1835.95	1837.51	1839.07	1840.63	1842.19	1843.75	1845.30	1846.86	1848.42	1849.98	9.60
9.70	1849.98	1851.53	1853.09	1854.65	1856.20	1857.76	1859.31	1860.87	1862.42	1863.97	1865.53	9.70
9.80	1865.53	1867.08	1868.63	1870.18	1871.74	1873.29	1874.84	1876.39	1877.94	1879.49	1881.04	9.80
9.90	1881.04	1882.59	1884.14	1885.69	1887.23	1888.78	1890.33	1891.88	1893.42	1894.97	1896.51	9.90
10.00	1896.51	1898.06	1899.60	1901.15	1902.69	1904.24	1905.78	1907.32	1908.87	1910.41	1911.95	10.00
10.10	1911.95	1913.49	1915.03	1916.57	1918.12	1919.66	1921.19	1922.73	1924.27	1925.81	1927.35	10.10
10.20	1927.35	1928.89	1930.43	1931.96	1933.50	1935.04	1936.57	1938.11	1939.64	1941.18	1942.71	10.20
10.30	1942.71	1944.25	1945.78	1947.31	1948.85	1950.38	1951.91	1953.45	1954.98	1956.51	1958.04	10.30
10.40	1958.04	1959.57	1961.10	1962.63	1964.16	1965.69	1967.22	1968.75	1970.28	1971.81	1973.34	10.40
10.50	1973.34	1974.87	1976.39	1977.92	1979.45	1980.98	1982.50	1984.03	1985.56	1987.08	1988.61	10.50
10.60	1988.61	1990.13	1991.66	1993.18	1994.71	1996.23	1997.75	1999.28	2000.80	2002.33	2003.85	10.60
10.70	2003.85	2005.37	2006.89	2008.42	2009.94	2011.46	2012.98	2014.50	2016.02	2017.54	2019.06	10.70
10.80	2019.06	2020.58	2022.10	2023.62	2025.14	2026.66	2028.18	2029.70	2031.22	2032.73	2034.25	10.80
10.90	2034.25	2035.77	2037.29	2038.80	2040.32	2041.84	2043.35	2044.87	2046.39	2047.90	2049.42	10.90
11.00	2049.42	2050.93	2052.45	2053.96	2055.48	2056.99	2058.50	2060.02	2061.53	2063.05	2064.56	11.00
11.10	2064.56	2066.07	2067.58	2069.10	2070.61	2072.12	2073.63	2075.14	2076.66	2078.17	2079.68	11.10
11.20	2079.68	2081.19	2082.70	2084.21	2085.72	2087.23	2088.74	2090.25	2091.76	2093.27	2094.77	11.20
11.30	2094.77	2096.28	2097.79	2099.30	2100.81	2102.32	2103.82	2105.33	2106.84	2108.34	2109.85	11.30
11.40	2109.85	2111.36	2112.86	2114.37	2115.88	2117.38	2118.89	2120.39	2121.90	2123.40	2124.91	11.40
11.50	2124.91	2126.41	2127.92	2129.42	2130.92	2132.43	2133.93	2135.44	2136.94	2138.44	2139.95	11.50
11.60	2139.95	2141.45	2142.95	2144.45	2145.96	2147.46	2148.96	2150.46	2151.96	2153.46	2154.96	11.60
11.70	2154.96	2156.47	2157.97	2159.47	2160.97	2162.47	2163.97	2165.47	2166.97	2168.47	2169.97	11.70
11.80	2169.97	2171.47	2172.97	2174.47	2175.96	2177.46	2178.96	2180.46	2181.96	2183.46	2184.95	11.80
11.90	2184.95	2186.45	2187.95	2189.45	2190.94	2192.44	2193.94	2195.44	2196.93	2198.43	2199.92	11.90
12.00	2199.92	2201.42	2202.92	2204.41	2205.91	2207.40	2208.90	2210.40	2211.89	2213.39	2214.88	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A2.2.2. *Type S thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
12.00	2199.92	2201.42	2202.92	2204.41	2205.91	2207.40	2208.90	2210.40	2211.89	2213.39	2214.88	12.00
12.10	2214.88	2216.38	2217.87	2219.37	2220.86	2222.35	2223.85	2225.34	2226.84	2228.33	2229.82	12.10
12.20	2229.82	2231.32	2232.81	2234.30	2235.80	2237.29	2238.78	2240.28	2241.77	2243.26	2244.75	12.20
12.30	2244.75	2246.25	2247.74	2249.23	2250.72	2252.21	2253.71	2255.20	2256.69	2258.18	2259.67	12.30
12.40	2259.67	2261.16	2262.65	2264.15	2265.64	2267.13	2268.62	2270.11	2271.60	2273.09	2274.58	12.40
12.50	2274.58	2276.07	2277.56	2279.05	2280.54	2282.03	2283.52	2285.01	2286.50	2287.99	2289.48	12.50
12.60	2289.48	2290.96	2292.45	2293.94	2295.43	2296.92	2298.41	2299.90	2301.39	2302.87	2304.36	12.60
12.70	2304.36	2305.85	2307.34	2308.83	2310.31	2311.80	2313.29	2314.78	2316.27	2317.75	2319.24	12.70
12.80	2319.24	2320.73	2322.22	2323.70	2325.19	2326.68	2328.16	2329.65	2331.14	2332.62	2334.11	12.80
12.90	2334.11	2335.60	2337.08	2338.57	2340.06	2341.54	2343.03	2344.52	2346.00	2347.49	2348.97	12.90
13.00	2348.97	2350.46	2351.95	2353.43	2354.92	2356.40	2357.89	2359.38	2360.86	2362.35	2363.83	13.00
13.10	2363.83	2365.32	2366.80	2368.29	2369.77	2371.26	2372.74	2374.23	2375.71	2377.20	2378.68	13.10
13.20	2378.68	2380.17	2381.65	2383.14	2384.62	2386.11	2387.59	2389.08	2390.56	2392.05	2393.53	13.20
13.30	2393.53	2395.01	2396.50	2397.98	2399.47	2400.95	2402.44	2403.92	2405.40	2406.89	2408.37	13.30
13.40	2408.37	2409.86	2411.34	2412.82	2414.31	2415.79	2417.28	2418.76	2420.24	2421.73	2423.21	13.40
13.50	2423.21	2424.70	2426.18	2427.66	2429.15	2430.63	2432.12	2433.60	2435.08	2436.57	2438.05	13.50
13.60	2438.05	2439.53	2441.02	2442.50	2443.98	2445.47	2446.95	2448.43	2449.92	2451.40	2452.89	13.60
13.70	2452.89	2454.37	2455.85	2457.34	2458.82	2460.30	2461.79	2463.27	2464.75	2466.24	2467.72	13.70
13.80	2467.72	2469.20	2470.69	2472.17	2473.65	2475.14	2476.62	2478.11	2479.59	2481.07	2482.56	13.80
13.90	2482.56	2484.04	2485.52	2487.01	2488.49	2489.97	2491.46	2492.94	2494.42	2495.91	2497.39	13.90
14.00	2497.39	2498.88	2500.36	2501.84	2503.33	2504.81	2506.29	2507.78	2509.26	2510.75	2512.23	14.00
14.10	2512.23	2513.71	2515.20	2516.68	2518.16	2519.65	2521.13	2522.62	2524.10	2525.58	2527.07	14.10
14.20	2527.07	2528.55	2530.04	2531.52	2533.01	2534.49	2535.97	2537.46	2538.94	2540.43	2541.91	14.20
14.30	2541.91	2543.40	2544.88	2546.37	2547.85	2549.33	2550.82	2552.30	2553.79	2555.27	2556.76	14.30
14.40	2556.76	2558.24	2559.73	2561.21	2562.70	2564.18	2565.67	2567.15	2568.64	2570.12	2571.61	14.40
14.50	2571.61	2573.10	2574.58	2576.07	2577.55	2579.04	2580.52	2582.01	2583.49	2584.98	2586.47	14.50
14.60	2586.47	2587.95	2589.44	2590.93	2592.41	2593.90	2595.38	2596.87	2598.36	2599.84	2601.33	14.60
14.70	2601.33	2602.82	2604.30	2605.79	2607.28	2608.76	2610.25	2611.74	2613.23	2614.71	2616.20	14.70
14.80	2616.20	2617.69	2619.18	2620.66	2622.15	2623.64	2625.13	2626.61	2628.10	2629.59	2631.08	14.80
14.90	2631.08	2632.57	2634.06	2635.54	2637.03	2638.52	2640.01	2641.50	2642.99	2644.48	2645.97	14.90
15.00	2645.97	2647.46	2648.94	2650.43	2651.92	2653.41	2654.90	2656.39	2657.88	2659.37	2660.86	15.00
15.10	2660.86	2662.35	2663.84	2665.33	2666.82	2668.31	2669.81	2671.30	2672.79	2674.28	2675.77	15.10
15.20	2675.77	2677.26	2678.75	2680.24	2681.74	2683.23	2684.72	2686.21	2687.70	2689.20	2690.69	15.20
15.30	2690.69	2692.18	2693.67	2695.17	2696.66	2698.15	2699.64	2701.14	2702.63	2704.12	2705.62	15.30
15.40	2705.62	2707.11	2708.61	2710.10	2711.59	2713.09	2714.58	2716.08	2717.57	2719.07	2720.56	15.40
15.50	2720.56	2722.06	2723.55	2725.05	2726.54	2728.04	2729.53	2731.03	2732.52	2734.02	2735.52	15.50
15.60	2735.52	2737.01	2738.51	2740.01	2741.50	2743.00	2744.50	2746.00	2747.49	2748.99	2750.49	15.60
15.70	2750.49	2751.99	2753.48	2754.98	2756.48	2757.98	2759.48	2760.98	2762.48	2763.98	2765.47	15.70
15.80	2765.47	2766.97	2768.47	2769.97	2771.47	2772.97	2774.47	2775.97	2777.48	2778.98	2780.48	15.80
15.90	2780.48	2781.98	2783.48	2784.98	2786.48	2787.99	2789.49	2790.99	2792.49	2793.99	2795.50	15.90
16.00	2795.50	2797.00	2798.50	2800.01	2801.51	2803.01	2804.52	2806.02	2807.53	2809.03	2810.53	16.00
16.10	2810.53	2812.04	2813.54	2815.05	2816.56	2818.06	2819.57	2821.07	2822.58	2824.09	2825.59	16.10
16.20	2825.59	2827.10	2828.61	2830.11	2831.62	2833.13	2834.64	2836.14	2837.65	2839.16	2840.67	16.20
16.30	2840.67	2842.18	2843.69	2845.20	2846.70	2848.21	2849.72	2851.23	2852.74	2854.25	2855.77	16.30
16.40	2855.77	2857.28	2858.79	2860.30	2861.81	2863.32	2864.83	2866.35	2867.86	2869.37	2870.88	16.40
16.50	2870.88	2872.40	2873.91	2875.42	2876.94	2878.45	2879.97	2881.48	2883.00	2884.51	2886.03	16.50
16.60	2886.03	2887.54	2889.06	2890.57	2892.09	2893.61	2895.12	2896.64	2898.16	2899.67	2901.19	16.60
16.70	2901.19	2902.71	2904.23	2905.74	2907.26	2908.78	2910.30	2911.82	2913.34	2914.86	2916.38	16.70
16.80	2916.38	2917.90	2919.42	2920.94	2922.46	2923.98	2925.51	2927.03	2928.55	2930.07	2931.60	16.80
16.90	2931.60	2933.12	2934.64	2936.16	2937.69	2939.21	2940.74	2942.26	2943.79	2945.31	2946.84	16.90
17.00	2946.84	2948.36	2949.89	2951.41	2952.94	2954.47	2955.99	2957.52	2959.05	2960.58	2962.11	17.00
17.10	2962.11	2963.63	2965.16	2966.69	2968.22	2969.75	2971.28	2972.81	2974.34	2975.87	2977.40	17.10
17.20	2977.40	2978.93	2980.47	2982.00	2983.53	2985.06	2986.60	2988.13	2989.66	2991.20	2992.73	17.20
17.30	2992.73	2994.27	2995.80	2997.33	2998.87	3000.41	3001.94	3003.48	3005.01	3006.55	3008.09	17.30
17.40	3008.09	3009.63	3011.16	3012.70	3014.24	3015.78	3017.32	3018.86	3020.40	3021.94	3023.48	17.40
17.50	3023.48	3025.02	3026.56	3028.10	3029.64	3031.19	3032.73	3034.27	3035.81	3037.36	3038.90	17.50
17.60	3038.90	3040.45	3041.99	3043.54	3045.08	3046.63	3048.17	3049.72	3051.27	3052.82	3054.37	17.60
17.70	3054.37	3055.92	3057.47	3059.02	3060.57	3062.12	3063.67	3065.22	3066.78	3068.33	3069.89	17.70
17.80	3069.89	3071.44	3073.00	3074.56	3076.11	3077.67	3079.23	3080.79	3082.35	3083.91	3085.48	17.80
17.90	3085.48	3087.04	3088.61	3090.17	3091.74	3093.30	3094.87	3096.44	3098.01	3099.58	3101.15	17.90
18.00	3101.15	3102.73	3104.30	3105.87	3107.45	3109.03	3110.60	3112.18	3113.76	3115.35	3116.93	18.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A2.2.2. *Type S thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
18.00	3101.15	3102.73	3104.30	3105.87	3107.45	3109.03	3110.60	3112.18	3113.76	3115.35	3116.93	18.00
18.10	3116.93	3118.51	3120.10	3121.68	3123.27	3124.86	3126.45	3128.04	3129.63	3131.23	3132.82	18.10
18.20	3132.82	3134.42	3136.01	3137.61	3139.21	3140.82	3142.42	3144.02	3145.63	3147.24	3148.85	18.20
18.30	3148.85	3150.46	3152.07	3153.68	3155.30	3156.92	3158.54	3160.16	3161.78	3163.40	3165.03	18.30
18.40	3165.03	3166.65	3168.28	3169.91	3171.55	3173.18	3174.82	3176.46	3178.10	3179.74	3181.38	18.40
18.50	3181.38	3183.03	3184.68	3186.33	3187.98	3189.63	3191.29	3192.95	3194.61	3196.27	3197.94	18.50
18.60	3197.94	3199.60	3201.27	3202.94	3204.62	3206.29	3207.97	3209.65	3211.34	3213.02		18.60
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A2.2.3. *Type S thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges (°C). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius*

Temperature Range (°C)	a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (°C)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
- 50 to 900	.....	..	1.6414048	-1	-2.0241757	-5	2.7849728	-9	-1.4172102	-13	-11 to 3
0 to 1100	.....	..	1.5445376	-1	-1.3349067	-5	1.3626587	-9	-5.3270847	-14	-3 to 6
0 to 1400	.....	..	1.4713897	-1	-9.0783455	-6	6.5660913	-10	-1.8499175	-14	-5 to 9
0 to 1650	.....	..	1.4260554	-1	-7.0073775	-6	3.8981279	-10	-8.3047780	-15	-6 to 11
0 to 1768	.....	..	1.4087955	-1	-6.3195007	-6	3.1267454	-10	-5.7422562	-15	-6 to 12
400 to 1100	4.1137317	+1	1.1599785	-1	-1.8642979	-6	1.2643267	-11	8.4828836	-16	-.05 to .07
400 to 1400	4.4507790	+1	1.1373998	-1	-1.3349811	-6	-3.9224680	-11	2.6563405	-15	-.08 to .08
400 to 1650	4.1670535	+1	1.1543356	-1	-1.6782780	-6	-1.0845801	-11	1.8379726	-15	-.2 to .2
1050 to 1400	-3.0938374	+1	1.4106560	-1	-4.9794442	-6	1.7334256	-10	-1.9262160	-15	-.003 to .003
1050 to 1650	1.2226507	+1	1.2706383	-1	-3.2873314	-6	8.3038098	-11	-1.3019379	-16	-.010 to .010
1400 to 1550	1.3866867	+2	9.3486676	-2	4.8592708	-8	-6.3885209	-11	2.2896541	-15	-.0005 to .0005
1400 to 1650	1.3923740	+2	9.3267401	-2	7.7266682	-8	-6.5458208	-11	2.3208160	-15	-.0005 to .0005
1400 to 1768	4.5133695	+3	-1.0046437	+0	1.0322002	-4	-4.3637046	-9	6.9361610	-14	-.13 to .10
1666 to 1768	2.3131446	+4	-5.4122671	+0	4.9347196	-4	-1.9681943	-8	2.9430179	-13	-.0005 to .0005
II. Cubic Equation											
- 50 to 900	.....	..	1.4892771	-1	-9.2057364	-6	5.0012263	-10	.....	..	-15 to 8
0 to 1100	.....	..	1.4240877	-1	-6.5638033	-6	2.6573556	-10	.....	..	-6 to 11
0 to 1400	.....	..	1.3715453	-1	-4.8700182	-6	1.4757404	-10	.....	..	-6 to 14
0 to 1650	.....	..	1.3463913	-1	-4.2368064	-6	1.1322621	-10	.....	..	-6 to 16
0 to 1768	.....	..	1.3395377	-1	-4.0890291	-6	1.0641068	-10	.....	..	-6 to 17
400 to 1100	3.9670850	+1	1.1698985	-1	-2.1008913	-6	3.6357564	-11	.....	..	-.07 to .07
400 to 1400	3.4637308	+1	1.1951016	-1	-2.4826134	-6	5.4128074	-11	.....	..	-.5 to .4
400 to 1650	3.0131902	+1	1.2155606	-1	-2.7524485	-6	6.4758217	-11	.....	..	-.6 to .7
1050 to 1400	1.1363334	+1	1.2706175	-1	-3.2496319	-6	7.8847884	-11	.....	..	-.007 to .006
1050 to 1650	1.6582222	+1	1.2575246	-1	-3.1410432	-6	7.5870390	-11	.....	..	-.009 to .012
1400 to 1550	1.4701444	+1	1.2602287	-1	-3.1517913	-6	7.5944250	-11	.....	..	-.0005 to .0005
1400 to 1650	-6.1978755	+0	1.3011835	-1	-3.4190337	-6	8.1750984	-11	.....	..	-.002 to .002
1400 to 1768	-5.7917146	+2	2.3822415	-1	-1.0199709	-5	2.2313554	-10	.....	..	-.4 to .2
1666 to 1768	-8.5574051	+3	1.5869380	+0	-8.6154939	-5	1.6481146	-9	.....	..	-.005 to .005
III. Quadratic Equation											
- 50 to 900	.....	..	1.3381613	-1	-3.3740912	-6	.....	..	.....	..	-19 to 16
0 to 1100	.....	..	1.2944550	-1	-2.6284659	-6	.....	..	.....	..	-10 to 20
0 to 1400	.....	..	1.2433510	-1	-1.9523967	-6	.....	..	.....	..	-13 to 25
0 to 1650	.....	..	1.2029856	-1	-1.5345668	-6	.....	..	.....	..	-19 to 30
0 to 1768	.....	..	1.1831935	-1	-1.3548756	-6	.....	..	.....	..	-22 to 33
400 to 1100	4.9665746	+1	1.1199825	-1	-1.3370085	-6	.....	..	.....	..	-.6 to .6
400 to 1400	6.1328808	+1	1.0809651	-1	-1.0529512	-6	.....	..	.....	..	-3 to 3
400 to 1650	7.7694617	+1	1.0322994	-1	-7.5275138	-7	.....	..	.....	..	-7 to 8
1050 to 1400	1.5392695	+2	9.1711175	-2	-3.4803175	-7	.....	..	.....	..	-.3 to .3
1050 to 1650	2.0492985	+2	8.3328900	-2	-8.7394818	-9	.....	..	.....	..	-1.1 to 1.1
1400 to 1550	2.8466845	+2	7.2912086	-2	3.2819279	-7	.....	..	.....	..	-.02 to .02
1400 to 1650	3.1839774	+2	6.8493986	-2	4.7262202	-7	.....	..	.....	..	-.09 to .09
1400 to 1768	4.1765334	+2	5.5919131	-2	8.6928188	-7	.....	..	.....	..	-.8 to .9
1666 to 1768	1.2490845	+3	-3.6971957	-2	3.4612646	-6	.....	..	.....	..	-.10 to .10

A3. Supplementary Data for Type R—Platinum—13% Rhodium Alloy versus Platinum Thermocouples

A3.1. Data for Voltage as a Function of Temperature

The full precision coefficients given in the main text are used to generate the voltage as a function of temperature data given in tables A3.1.1 and A3.1.2. Table A3.1.1 presents the data in degrees Celsius from -50°C to 1768°C while table A3.1.2 presents the data in degrees Fahrenheit from -58°F to 3214°F . Table A3.1.3 contains quadratic, cubic, and quartic approximations to the data as a function of temperature in selected temperature ranges. The error range given in the table is the difference between the voltage as obtained from the full precision coefficients from the text and the respective reduced order approximations. The last entries in the cubic and quadratic groupings of table A3.1.3 represent variable reference junction corrections in the 0 to 50°C temperature range. In the narrower temperature range near room temperatures, 20 to 25°C , the error range for the given quadratic equation is smaller than that listed in the last column: $\pm 0.04 \mu\text{V}$.

TABLE A3.1.1. *Type R thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C*

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-50	-0.226											-50
-40	-0.188	-0.192	-0.196	-0.200	-0.204	-0.207	-0.211	-0.215	-0.219	-0.223	-0.226	-40
-30	-0.145	-0.150	-0.154	-0.158	-0.163	-0.167	-0.171	-0.175	-0.180	-0.184	-0.188	-30
-20	-0.100	-0.105	-0.109	-0.114	-0.119	-0.123	-0.128	-0.132	-0.137	-0.141	-0.145	-20
-10	-0.051	-0.056	-0.061	-0.066	-0.071	-0.076	-0.081	-0.086	-0.091	-0.095	-0.100	-10
- 0	0.000	-0.005	-0.011	-0.016	-0.021	-0.026	-0.031	-0.036	-0.041	-0.046	-0.051	- 0
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A3.1.1. *Type R thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C —Continued*

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	0.000	0.005	0.011	0.016	0.021	0.027	0.032	0.038	0.043	0.049	0.054	0
10	0.054	0.060	0.065	0.071	0.077	0.082	0.088	0.094	0.100	0.105	0.111	10
20	0.111	0.117	0.123	0.129	0.135	0.141	0.147	0.152	0.158	0.165	0.171	20
30	0.171	0.177	0.183	0.189	0.195	0.201	0.207	0.214	0.220	0.226	0.232	30
40	0.232	0.239	0.245	0.251	0.258	0.264	0.271	0.277	0.283	0.290	0.296	40
50	0.296	0.303	0.310	0.316	0.323	0.329	0.336	0.343	0.349	0.356	0.363	50
60	0.363	0.369	0.376	0.383	0.390	0.397	0.403	0.410	0.417	0.424	0.431	60
70	0.431	0.438	0.445	0.452	0.459	0.466	0.473	0.480	0.487	0.494	0.501	70
80	0.501	0.508	0.515	0.523	0.530	0.537	0.544	0.552	0.559	0.566	0.573	80
90	0.573	0.581	0.588	0.595	0.603	0.610	0.617	0.625	0.632	0.640	0.647	90
100	0.647	0.655	0.662	0.670	0.677	0.685	0.692	0.700	0.708	0.715	0.723	100
110	0.723	0.730	0.738	0.746	0.754	0.761	0.769	0.777	0.784	0.792	0.800	110
120	0.800	0.808	0.816	0.824	0.831	0.839	0.847	0.855	0.863	0.871	0.879	120
130	0.879	0.887	0.895	0.903	0.911	0.919	0.927	0.935	0.943	0.951	0.959	130
140	0.959	0.967	0.975	0.983	0.992	1.000	1.008	1.016	1.024	1.032	1.041	140
150	1.041	1.049	1.057	1.065	1.074	1.082	1.090	1.099	1.107	1.115	1.124	150
160	1.124	1.132	1.140	1.149	1.157	1.166	1.174	1.183	1.191	1.200	1.208	160
170	1.208	1.217	1.225	1.234	1.242	1.251	1.259	1.268	1.276	1.285	1.294	170
180	1.294	1.302	1.311	1.319	1.328	1.337	1.345	1.354	1.363	1.372	1.380	180
190	1.380	1.389	1.398	1.407	1.415	1.424	1.433	1.442	1.450	1.459	1.468	190
200	1.468	1.477	1.486	1.495	1.504	1.512	1.521	1.530	1.539	1.548	1.557	200
210	1.557	1.566	1.575	1.584	1.593	1.602	1.611	1.620	1.629	1.638	1.647	210
220	1.647	1.656	1.665	1.674	1.683	1.692	1.702	1.711	1.720	1.729	1.738	220
230	1.738	1.747	1.756	1.766	1.775	1.784	1.793	1.802	1.812	1.821	1.830	230
240	1.830	1.839	1.849	1.858	1.867	1.876	1.886	1.895	1.904	1.914	1.923	240
250	1.923	1.932	1.942	1.951	1.960	1.970	1.979	1.988	1.998	2.007	2.017	250
260	2.017	2.026	2.036	2.045	2.054	2.064	2.073	2.083	2.092	2.102	2.111	260
270	2.111	2.121	2.130	2.140	2.149	2.159	2.169	2.178	2.188	2.197	2.207	270
280	2.207	2.216	2.226	2.236	2.245	2.255	2.264	2.274	2.284	2.293	2.303	280
290	2.303	2.313	2.322	2.332	2.342	2.351	2.361	2.371	2.381	2.390	2.400	290
300	2.400	2.410	2.420	2.429	2.439	2.449	2.459	2.468	2.478	2.488	2.498	300
310	2.498	2.508	2.517	2.527	2.537	2.547	2.557	2.567	2.577	2.586	2.596	310
320	2.596	2.606	2.616	2.626	2.636	2.646	2.656	2.666	2.676	2.685	2.695	320
330	2.695	2.705	2.715	2.725	2.735	2.745	2.755	2.765	2.775	2.785	2.795	330
340	2.795	2.805	2.815	2.825	2.835	2.845	2.855	2.866	2.876	2.886	2.896	340
350	2.896	2.906	2.916	2.926	2.936	2.946	2.956	2.966	2.977	2.987	2.997	350
360	2.997	3.007	3.017	3.027	3.037	3.048	3.058	3.068	3.078	3.088	3.099	360
370	3.099	3.109	3.119	3.129	3.139	3.150	3.160	3.170	3.180	3.191	3.201	370
380	3.201	3.211	3.221	3.232	3.242	3.252	3.263	3.273	3.283	3.293	3.304	380
390	3.304	3.314	3.324	3.335	3.345	3.355	3.366	3.376	3.386	3.397	3.407	390
400	3.407	3.418	3.428	3.438	3.449	3.459	3.470	3.480	3.490	3.501	3.511	400
410	3.511	3.522	3.532	3.543	3.553	3.563	3.574	3.584	3.595	3.605	3.616	410
420	3.616	3.626	3.637	3.647	3.658	3.668	3.679	3.689	3.700	3.710	3.721	420
430	3.721	3.731	3.742	3.752	3.763	3.774	3.784	3.795	3.805	3.816	3.826	430
440	3.826	3.837	3.848	3.858	3.869	3.879	3.890	3.901	3.911	3.922	3.933	440
450	3.933	3.943	3.954	3.964	3.975	3.986	3.996	4.007	4.018	4.028	4.039	450
460	4.039	4.050	4.061	4.071	4.082	4.093	4.103	4.114	4.125	4.136	4.146	460
470	4.146	4.157	4.168	4.178	4.189	4.200	4.211	4.222	4.232	4.243	4.254	470
480	4.254	4.265	4.275	4.286	4.297	4.308	4.319	4.329	4.340	4.351	4.362	480
490	4.362	4.373	4.384	4.394	4.405	4.416	4.427	4.438	4.449	4.460	4.471	490
500	4.471	4.481	4.492	4.503	4.514	4.525	4.536	4.547	4.558	4.569	4.580	500
510	4.580	4.591	4.601	4.612	4.623	4.634	4.645	4.656	4.667	4.678	4.689	510
520	4.689	4.700	4.711	4.722	4.733	4.744	4.755	4.766	4.777	4.788	4.799	520
530	4.799	4.810	4.821	4.832	4.843	4.854	4.865	4.876	4.888	4.899	4.910	530
540	4.910	4.921	4.932	4.943	4.954	4.965	4.976	4.987	4.998	5.009	5.021	540
550	5.021	5.032	5.043	5.054	5.065	5.076	5.087	5.099	5.110	5.121	5.132	550
560	5.132	5.143	5.154	5.166	5.177	5.188	5.199	5.210	5.221	5.233	5.244	560
570	5.244	5.255	5.266	5.278	5.289	5.300	5.311	5.322	5.334	5.345	5.356	570
580	5.356	5.368	5.379	5.390	5.401	5.413	5.424	5.435	5.446	5.458	5.469	580
590	5.469	5.480	5.492	5.503	5.514	5.526	5.537	5.548	5.560	5.571	5.582	590
600	5.582	5.594	5.605	5.616	5.628	5.639	5.650	5.662	5.673	5.685	5.696	600
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A3.1.1. Type R thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C —Continued

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	5.582	5.594	5.605	5.616	5.628	5.639	5.650	5.662	5.673	5.685	5.696	600
610	5.696	5.707	5.719	5.730	5.742	5.753	5.764	5.776	5.787	5.799	5.810	610
620	5.810	5.821	5.833	5.844	5.856	5.867	5.879	5.890	5.902	5.913	5.925	620
630	5.925	5.936	5.948	5.959	5.971	5.982	5.994	6.005	6.017	6.028	6.040	630
640	6.040	6.051	6.063	6.074	6.086	6.098	6.109	6.121	6.132	6.144	6.155	640
650	6.155	6.167	6.179	6.190	6.202	6.213	6.225	6.237	6.248	6.260	6.272	650
660	6.272	6.283	6.295	6.307	6.318	6.330	6.342	6.353	6.365	6.377	6.388	660
670	6.388	6.400	6.412	6.423	6.435	6.447	6.458	6.470	6.482	6.494	6.505	670
680	6.505	6.517	6.529	6.541	6.552	6.564	6.576	6.588	6.599	6.611	6.623	680
690	6.623	6.635	6.647	6.658	6.670	6.682	6.694	6.706	6.718	6.729	6.741	690
700	6.741	6.753	6.765	6.777	6.789	6.800	6.812	6.824	6.836	6.848	6.860	700
710	6.860	6.872	6.884	6.895	6.907	6.919	6.931	6.943	6.955	6.967	6.979	710
720	6.979	6.991	7.003	7.015	7.027	7.039	7.051	7.063	7.074	7.086	7.098	720
730	7.098	7.110	7.122	7.134	7.146	7.158	7.170	7.182	7.194	7.206	7.218	730
740	7.218	7.231	7.243	7.255	7.267	7.279	7.291	7.303	7.315	7.327	7.339	740
750	7.339	7.351	7.363	7.375	7.387	7.399	7.412	7.424	7.436	7.448	7.460	750
760	7.460	7.472	7.484	7.496	7.509	7.521	7.533	7.545	7.557	7.569	7.582	760
770	7.582	7.594	7.606	7.618	7.630	7.642	7.655	7.667	7.679	7.691	7.703	770
780	7.703	7.716	7.728	7.740	7.752	7.765	7.777	7.789	7.801	7.814	7.826	780
790	7.826	7.838	7.850	7.863	7.875	7.887	7.900	7.912	7.924	7.937	7.949	790
800	7.949	7.961	7.973	7.986	7.998	8.010	8.023	8.035	8.047	8.060	8.072	800
810	8.072	8.085	8.097	8.109	8.122	8.134	8.146	8.159	8.171	8.184	8.196	810
820	8.196	8.208	8.221	8.233	8.246	8.258	8.271	8.283	8.295	8.308	8.320	820
830	8.320	8.333	8.345	8.358	8.370	8.383	8.395	8.408	8.420	8.433	8.445	830
840	8.445	8.458	8.470	8.483	8.495	8.508	8.520	8.533	8.545	8.558	8.570	840
850	8.570	8.583	8.595	8.608	8.621	8.633	8.646	8.658	8.671	8.683	8.696	850
860	8.696	8.709	8.721	8.734	8.746	8.759	8.772	8.784	8.797	8.810	8.822	860
870	8.822	8.835	8.847	8.860	8.873	8.885	8.898	8.911	8.923	8.936	8.949	870
880	8.949	8.961	8.974	8.987	9.000	9.012	9.025	9.038	9.050	9.063	9.076	880
890	9.076	9.089	9.101	9.114	9.127	9.140	9.152	9.165	9.178	9.191	9.203	890
900	9.203	9.216	9.229	9.242	9.254	9.267	9.280	9.293	9.306	9.319	9.331	900
910	9.331	9.344	9.357	9.370	9.383	9.395	9.408	9.421	9.434	9.447	9.460	910
920	9.460	9.473	9.485	9.498	9.511	9.524	9.537	9.550	9.563	9.576	9.589	920
930	9.589	9.602	9.614	9.627	9.640	9.653	9.666	9.679	9.692	9.705	9.718	930
940	9.718	9.731	9.744	9.757	9.770	9.783	9.796	9.809	9.822	9.835	9.848	940
950	9.848	9.861	9.874	9.887	9.900	9.913	9.926	9.939	9.952	9.965	9.978	950
960	9.978	9.991	10.004	10.017	10.030	10.043	10.056	10.069	10.082	10.095	10.109	960
970	10.109	10.122	10.135	10.148	10.161	10.174	10.187	10.200	10.213	10.227	10.240	970
980	10.240	10.253	10.266	10.279	10.292	10.305	10.319	10.332	10.345	10.358	10.371	980
990	10.371	10.384	10.398	10.411	10.424	10.437	10.450	10.464	10.477	10.490	10.503	990
1,000	10.503	10.516	10.530	10.543	10.556	10.569	10.583	10.596	10.609	10.622	10.636	1,000
1,010	10.636	10.649	10.662	10.675	10.689	10.702	10.715	10.729	10.742	10.755	10.768	1,010
1,020	10.768	10.782	10.795	10.808	10.822	10.835	10.848	10.862	10.875	10.888	10.902	1,020
1,030	10.902	10.915	10.928	10.942	10.955	10.968	10.982	10.995	11.009	11.022	11.035	1,030
1,040	11.035	11.049	11.062	11.076	11.089	11.102	11.116	11.129	11.143	11.156	11.170	1,040
1,050	11.170	11.183	11.196	11.210	11.223	11.237	11.250	11.264	11.277	11.291	11.304	1,050
1,060	11.304	11.318	11.331	11.345	11.358	11.372	11.385	11.399	11.412	11.426	11.439	1,060
1,070	11.439	11.453	11.466	11.480	11.493	11.507	11.520	11.534	11.547	11.561	11.574	1,070
1,080	11.574	11.588	11.602	11.615	11.629	11.642	11.656	11.669	11.683	11.697	11.710	1,080
1,090	11.710	11.724	11.737	11.751	11.765	11.778	11.792	11.805	11.819	11.833	11.846	1,090
1,100	11.846	11.860	11.874	11.887	11.901	11.914	11.928	11.942	11.955	11.969	11.983	1,100
1,110	11.983	11.996	12.010	12.024	12.037	12.051	12.065	12.078	12.092	12.106	12.119	1,110
1,120	12.119	12.133	12.147	12.161	12.174	12.188	12.202	12.215	12.229	12.243	12.257	1,120
1,130	12.257	12.270	12.284	12.298	12.311	12.325	12.339	12.353	12.366	12.380	12.394	1,130
1,140	12.394	12.408	12.421	12.435	12.449	12.463	12.476	12.490	12.504	12.518	12.532	1,140
1,150	12.532	12.545	12.559	12.573	12.587	12.600	12.614	12.628	12.642	12.656	12.669	1,150
1,160	12.669	12.683	12.697	12.711	12.725	12.739	12.752	12.766	12.780	12.794	12.808	1,160
1,170	12.808	12.822	12.835	12.849	12.863	12.877	12.891	12.905	12.918	12.932	12.946	1,170
1,180	12.946	12.960	12.974	12.988	13.002	13.016	13.029	13.043	13.057	13.071	13.085	1,180
1,190	13.085	13.099	13.113	13.127	13.140	13.154	13.168	13.182	13.196	13.210	13.224	1,190
1,200	13.224	13.238	13.252	13.266	13.280	13.293	13.307	13.321	13.335	13.349	13.363	1,200

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
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TABLE A3.1.1. *Type R thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C —Continued*

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,200	13.224	13.238	13.252	13.266	13.280	13.293	13.307	13.321	13.335	13.349	13.363	1,200
1,210	13.363	13.377	13.391	13.405	13.419	13.433	13.447	13.461	13.475	13.489	13.502	1,210
1,220	13.502	13.516	13.530	13.544	13.558	13.572	13.586	13.600	13.614	13.628	13.642	1,220
1,230	13.642	13.656	13.670	13.684	13.698	13.712	13.726	13.740	13.754	13.768	13.782	1,230
1,240	13.782	13.796	13.810	13.824	13.838	13.852	13.866	13.880	13.894	13.908	13.922	1,240
1,250	13.922	13.936	13.950	13.964	13.978	13.992	14.006	14.020	14.034	14.048	14.062	1,250
1,260	14.062	14.076	14.090	14.104	14.118	14.132	14.146	14.160	14.174	14.188	14.202	1,260
1,270	14.202	14.216	14.230	14.244	14.258	14.272	14.286	14.301	14.315	14.329	14.343	1,270
1,280	14.343	14.357	14.371	14.385	14.399	14.413	14.427	14.441	14.455	14.469	14.483	1,280
1,290	14.483	14.497	14.511	14.525	14.539	14.554	14.568	14.582	14.596	14.610	14.624	1,290
1,300	14.624	14.638	14.652	14.666	14.680	14.694	14.708	14.722	14.737	14.751	14.765	1,300
1,310	14.765	14.779	14.793	14.807	14.821	14.835	14.849	14.863	14.877	14.891	14.906	1,310
1,320	14.906	14.920	14.934	14.948	14.962	14.976	14.990	15.004	15.018	15.032	15.047	1,320
1,330	15.047	15.061	15.075	15.089	15.103	15.117	15.131	15.145	15.159	15.173	15.188	1,330
1,340	15.188	15.202	15.216	15.230	15.244	15.258	15.272	15.286	15.300	15.315	15.329	1,340
1,350	15.329	15.343	15.357	15.371	15.385	15.399	15.413	15.427	15.442	15.456	15.470	1,350
1,360	15.470	15.484	15.498	15.512	15.526	15.540	15.555	15.569	15.583	15.597	15.611	1,360
1,370	15.611	15.625	15.639	15.653	15.667	15.682	15.696	15.710	15.724	15.738	15.752	1,370
1,380	15.752	15.766	15.780	15.795	15.809	15.823	15.837	15.851	15.865	15.879	15.893	1,380
1,390	15.893	15.908	15.922	15.936	15.950	15.964	15.978	15.992	16.006	16.021	16.035	1,390
1,400	16.035	16.049	16.063	16.077	16.091	16.105	16.119	16.134	16.148	16.162	16.176	1,400
1,410	16.176	16.190	16.204	16.218	16.232	16.247	16.261	16.275	16.289	16.303	16.317	1,410
1,420	16.317	16.331	16.345	16.360	16.374	16.388	16.402	16.416	16.430	16.444	16.458	1,420
1,430	16.458	16.472	16.487	16.501	16.515	16.529	16.543	16.557	16.571	16.585	16.599	1,430
1,440	16.599	16.614	16.628	16.642	16.656	16.670	16.684	16.698	16.712	16.726	16.741	1,440
1,450	16.741	16.755	16.769	16.783	16.797	16.811	16.825	16.839	16.853	16.867	16.882	1,450
1,460	16.882	16.896	16.910	16.924	16.938	16.952	16.966	16.980	16.994	17.008	17.022	1,460
1,470	17.022	17.037	17.051	17.065	17.079	17.093	17.107	17.121	17.135	17.149	17.163	1,470
1,480	17.163	17.177	17.192	17.206	17.220	17.234	17.248	17.262	17.276	17.290	17.304	1,480
1,490	17.304	17.318	17.332	17.346	17.360	17.374	17.388	17.403	17.417	17.431	17.445	1,490
1,500	17.445	17.459	17.473	17.487	17.501	17.515	17.529	17.543	17.557	17.571	17.585	1,500
1,510	17.585	17.599	17.613	17.627	17.641	17.655	17.669	17.684	17.698	17.712	17.726	1,510
1,520	17.726	17.740	17.754	17.768	17.782	17.796	17.810	17.824	17.838	17.852	17.866	1,520
1,530	17.866	17.880	17.894	17.908	17.922	17.936	17.950	17.964	17.978	17.992	18.006	1,530
1,540	18.006	18.020	18.034	18.048	18.062	18.076	18.090	18.104	18.118	18.132	18.146	1,540
1,550	18.146	18.160	18.174	18.188	18.202	18.216	18.230	18.244	18.258	18.272	18.286	1,550
1,560	18.286	18.299	18.313	18.327	18.341	18.355	18.369	18.383	18.397	18.411	18.425	1,560
1,570	18.425	18.439	18.453	18.467	18.481	18.495	18.509	18.523	18.537	18.550	18.564	1,570
1,580	18.564	18.578	18.592	18.606	18.620	18.634	18.648	18.662	18.676	18.690	18.703	1,580
1,590	18.703	18.717	18.731	18.745	18.759	18.773	18.787	18.801	18.815	18.828	18.842	1,590
1,600	18.842	18.856	18.870	18.884	18.898	18.912	18.926	18.939	18.953	18.967	18.981	1,600
1,610	18.981	18.995	19.009	19.023	19.036	19.050	19.064	19.078	19.092	19.106	19.119	1,610
1,620	19.119	19.133	19.147	19.161	19.175	19.188	19.202	19.216	19.230	19.244	19.257	1,620
1,630	19.257	19.271	19.285	19.299	19.313	19.326	19.340	19.354	19.368	19.382	19.395	1,630
1,640	19.395	19.409	19.423	19.437	19.450	19.464	19.478	19.492	19.505	19.519	19.533	1,640
1,650	19.533	19.547	19.560	19.574	19.588	19.602	19.615	19.629	19.643	19.656	19.670	1,650
1,660	19.670	19.684	19.698	19.711	19.725	19.739	19.752	19.766	19.780	19.793	19.807	1,660
1,670	19.807	19.821	19.834	19.848	19.862	19.875	19.889	19.903	19.916	19.930	19.944	1,670
1,680	19.944	19.957	19.971	19.985	19.998	20.012	20.025	20.039	20.053	20.066	20.080	1,680
1,690	20.080	20.093	20.107	20.120	20.134	20.148	20.161	20.175	20.188	20.202	20.215	1,690
1,700	20.215	20.229	20.242	20.256	20.269	20.283	20.296	20.309	20.323	20.336	20.350	1,700
1,710	20.350	20.363	20.377	20.390	20.403	20.417	20.430	20.443	20.457	20.470	20.483	1,710
1,720	20.483	20.497	20.510	20.523	20.537	20.550	20.563	20.576	20.590	20.603	20.616	1,720
1,730	20.616	20.629	20.642	20.656	20.669	20.682	20.695	20.708	20.721	20.734	20.748	1,730
1,740	20.748	20.761	20.774	20.787	20.800	20.813	20.826	20.839	20.852	20.865	20.878	1,740
1,750	20.878	20.891	20.904	20.916	20.929	20.942	20.955	20.968	20.981	20.994	21.006	1,750
1,760	21.006	21.019	21.032	21.045	21.057	21.070	21.083	21.096	21.108			1,760
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A3.1.2. *Type R thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F*

$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-50	-0.210	-0.212	-0.214	-0.216	-0.218	-0.220	-0.222	-0.224	-0.226			-50
-40	-0.188	-0.190	-0.192	-0.194	-0.197	-0.199	-0.201	-0.203	-0.205	-0.207	-0.210	-40
-30	-0.165	-0.167	-0.169	-0.172	-0.174	-0.176	-0.179	-0.181	-0.183	-0.185	-0.188	-30
-20	-0.141	-0.143	-0.145	-0.148	-0.150	-0.153	-0.155	-0.158	-0.160	-0.162	-0.165	-20
-10	-0.116	-0.118	-0.121	-0.123	-0.126	-0.128	-0.131	-0.133	-0.136	-0.138	-0.141	-10
- 0	-0.089	-0.092	-0.095	-0.097	-0.100	-0.103	-0.105	-0.108	-0.110	-0.113	-0.116	- 0
$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$

TABLE A3.1.2. Type R thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	-0.089	-0.087	-0.084	-0.082	-0.079	-0.076	-0.073	-0.071	-0.068	-0.065	-0.063	0
10	-0.063	-0.060	-0.057	-0.054	-0.051	-0.049	-0.046	-0.043	-0.040	-0.037	-0.035	10
20	-0.035	-0.032	-0.029	-0.026	-0.023	-0.020	-0.017	-0.015	-0.012	-0.009	-0.006	20
30	-0.006	-0.003	0.000	0.003	0.006	0.009	0.012	0.015	0.018	0.021	0.024	30
40	0.024	0.027	0.030	0.033	0.036	0.039	0.042	0.045	0.048	0.051	0.054	40
50	0.054	0.057	0.060	0.064	0.067	0.070	0.073	0.076	0.079	0.082	0.086	50
60	0.086	0.089	0.092	0.095	0.098	0.101	0.105	0.108	0.111	0.114	0.118	60
70	0.118	0.121	0.124	0.127	0.131	0.134	0.137	0.141	0.144	0.147	0.150	70
80	0.150	0.154	0.157	0.161	0.164	0.167	0.171	0.174	0.177	0.181	0.184	80
90	0.184	0.188	0.191	0.194	0.198	0.201	0.205	0.208	0.212	0.215	0.218	90
100	0.218	0.222	0.225	0.229	0.232	0.236	0.239	0.243	0.246	0.250	0.253	100
110	0.253	0.257	0.261	0.264	0.268	0.271	0.275	0.278	0.282	0.286	0.289	110
120	0.289	0.293	0.296	0.300	0.304	0.307	0.311	0.315	0.318	0.322	0.326	120
130	0.326	0.329	0.333	0.337	0.340	0.344	0.348	0.351	0.355	0.359	0.363	130
140	0.363	0.366	0.370	0.374	0.378	0.381	0.385	0.389	0.393	0.397	0.400	140
150	0.400	0.404	0.408	0.412	0.416	0.419	0.423	0.427	0.431	0.435	0.439	150
160	0.439	0.443	0.446	0.450	0.454	0.458	0.462	0.466	0.470	0.474	0.478	160
170	0.478	0.482	0.485	0.489	0.493	0.497	0.501	0.505	0.509	0.513	0.517	170
180	0.517	0.521	0.525	0.529	0.533	0.537	0.541	0.545	0.549	0.553	0.557	180
190	0.557	0.561	0.565	0.569	0.573	0.577	0.581	0.586	0.590	0.594	0.598	190
200	0.598	0.602	0.606	0.610	0.614	0.618	0.622	0.627	0.631	0.635	0.639	200
210	0.639	0.643	0.647	0.651	0.656	0.660	0.664	0.668	0.672	0.676	0.681	210
220	0.681	0.685	0.689	0.693	0.697	0.702	0.706	0.710	0.714	0.719	0.723	220
230	0.723	0.727	0.731	0.736	0.740	0.744	0.748	0.753	0.757	0.761	0.766	230
240	0.766	0.770	0.774	0.778	0.783	0.787	0.791	0.796	0.800	0.804	0.809	240
250	0.809	0.813	0.817	0.822	0.826	0.830	0.835	0.839	0.844	0.848	0.852	250
260	0.852	0.857	0.861	0.866	0.870	0.874	0.879	0.883	0.888	0.892	0.897	260
270	0.897	0.901	0.905	0.910	0.914	0.919	0.923	0.928	0.932	0.937	0.941	270
280	0.941	0.946	0.950	0.955	0.959	0.964	0.968	0.973	0.977	0.982	0.986	280
290	0.986	0.991	0.995	1.000	1.004	1.009	1.013	1.018	1.022	1.027	1.032	290
300	1.032	1.036	1.041	1.045	1.050	1.054	1.059	1.064	1.068	1.073	1.077	300
310	1.077	1.082	1.087	1.091	1.096	1.101	1.105	1.110	1.114	1.119	1.124	310
320	1.124	1.128	1.133	1.138	1.142	1.147	1.152	1.156	1.161	1.166	1.170	320
330	1.170	1.175	1.180	1.184	1.189	1.194	1.199	1.203	1.208	1.213	1.217	330
340	1.217	1.222	1.227	1.232	1.236	1.241	1.246	1.251	1.255	1.260	1.265	340
350	1.265	1.270	1.274	1.279	1.284	1.289	1.294	1.298	1.303	1.308	1.313	350
360	1.313	1.318	1.322	1.327	1.332	1.337	1.342	1.346	1.351	1.356	1.361	360
370	1.361	1.366	1.371	1.375	1.380	1.385	1.390	1.395	1.400	1.405	1.409	370
380	1.409	1.414	1.419	1.424	1.429	1.434	1.439	1.444	1.449	1.453	1.458	380
390	1.458	1.463	1.468	1.473	1.478	1.483	1.488	1.493	1.498	1.503	1.508	390
400	1.508	1.512	1.517	1.522	1.527	1.532	1.537	1.542	1.547	1.552	1.557	400
410	1.557	1.562	1.567	1.572	1.577	1.582	1.587	1.592	1.597	1.602	1.607	410
420	1.607	1.612	1.617	1.622	1.627	1.632	1.637	1.642	1.647	1.652	1.657	420
430	1.657	1.662	1.667	1.672	1.677	1.682	1.687	1.692	1.698	1.703	1.708	430
440	1.708	1.713	1.718	1.723	1.728	1.733	1.738	1.743	1.748	1.753	1.758	440
450	1.758	1.764	1.769	1.774	1.779	1.784	1.789	1.794	1.799	1.804	1.810	450
460	1.810	1.815	1.820	1.825	1.830	1.835	1.840	1.845	1.851	1.856	1.861	460
470	1.861	1.866	1.871	1.876	1.882	1.887	1.892	1.897	1.902	1.907	1.913	470
480	1.913	1.918	1.923	1.928	1.933	1.938	1.944	1.949	1.954	1.959	1.964	480
490	1.964	1.970	1.975	1.980	1.985	1.991	1.996	2.001	2.006	2.011	2.017	490
500	2.017	2.022	2.027	2.032	2.038	2.043	2.048	2.053	2.059	2.064	2.069	500
510	2.069	2.074	2.080	2.085	2.090	2.095	2.101	2.106	2.111	2.117	2.122	510
520	2.122	2.127	2.132	2.138	2.143	2.148	2.154	2.159	2.164	2.170	2.175	520
530	2.175	2.180	2.186	2.191	2.196	2.201	2.207	2.212	2.217	2.223	2.228	530
540	2.228	2.233	2.239	2.244	2.249	2.255	2.260	2.266	2.271	2.276	2.282	540
550	2.282	2.287	2.292	2.298	2.303	2.308	2.314	2.319	2.325	2.330	2.335	550
560	2.335	2.341	2.346	2.351	2.357	2.362	2.368	2.373	2.378	2.384	2.389	560
570	2.389	2.395	2.400	2.405	2.411	2.416	2.422	2.427	2.433	2.438	2.443	570
580	2.443	2.449	2.454	2.460	2.465	2.471	2.476	2.481	2.487	2.492	2.498	580
590	2.498	2.503	2.509	2.514	2.520	2.525	2.531	2.536	2.541	2.547	2.552	590
600	2.552	2.558	2.563	2.569	2.574	2.580	2.585	2.591	2.596	2.602	2.607	600
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A3.1.2. Type R thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	2.552	2.558	2.563	2.569	2.574	2.580	2.585	2.591	2.596	2.602	2.607	600
610	2.607	2.613	2.618	2.624	2.629	2.635	2.640	2.646	2.651	2.657	2.662	610
620	2.662	2.668	2.673	2.679	2.684	2.690	2.695	2.701	2.706	2.712	2.718	620
630	2.718	2.723	2.729	2.734	2.740	2.745	2.751	2.756	2.762	2.767	2.773	630
640	2.773	2.779	2.784	2.790	2.795	2.801	2.806	2.812	2.818	2.823	2.829	640
650	2.829	2.834	2.840	2.845	2.851	2.857	2.862	2.868	2.873	2.879	2.885	650
660	2.885	2.890	2.896	2.901	2.907	2.913	2.918	2.924	2.929	2.935	2.941	660
670	2.941	2.946	2.952	2.957	2.963	2.969	2.974	2.980	2.986	2.991	2.997	670
680	2.997	3.002	3.008	3.014	3.019	3.025	3.031	3.036	3.042	3.048	3.053	680
690	3.053	3.059	3.065	3.070	3.076	3.082	3.087	3.093	3.099	3.104	3.110	690
700	3.110	3.116	3.121	3.127	3.133	3.138	3.144	3.150	3.155	3.161	3.167	700
710	3.167	3.172	3.178	3.184	3.189	3.195	3.201	3.207	3.212	3.218	3.224	710
720	3.224	3.229	3.235	3.241	3.247	3.252	3.258	3.264	3.269	3.275	3.281	720
730	3.281	3.287	3.292	3.298	3.304	3.309	3.315	3.321	3.327	3.332	3.338	730
740	3.338	3.344	3.350	3.355	3.361	3.367	3.373	3.378	3.384	3.390	3.396	740
750	3.396	3.401	3.407	3.413	3.419	3.424	3.430	3.436	3.442	3.448	3.453	750
760	3.453	3.459	3.465	3.471	3.476	3.482	3.488	3.494	3.500	3.505	3.511	760
770	3.511	3.517	3.523	3.529	3.534	3.540	3.546	3.552	3.558	3.563	3.569	770
780	3.569	3.575	3.581	3.587	3.592	3.598	3.604	3.610	3.616	3.622	3.627	780
790	3.627	3.633	3.639	3.645	3.651	3.657	3.662	3.668	3.674	3.680	3.686	790
800	3.686	3.692	3.697	3.703	3.709	3.715	3.721	3.727	3.733	3.738	3.744	800
810	3.744	3.750	3.756	3.762	3.768	3.774	3.779	3.785	3.791	3.797	3.803	810
820	3.803	3.809	3.815	3.821	3.826	3.832	3.838	3.844	3.850	3.856	3.862	820
830	3.862	3.868	3.874	3.879	3.885	3.891	3.897	3.903	3.909	3.915	3.921	830
840	3.921	3.927	3.933	3.938	3.944	3.950	3.956	3.962	3.968	3.974	3.980	840
850	3.980	3.986	3.992	3.998	4.004	4.009	4.015	4.021	4.027	4.033	4.039	850
860	4.039	4.045	4.051	4.057	4.063	4.069	4.075	4.081	4.087	4.093	4.099	860
870	4.099	4.105	4.110	4.116	4.122	4.128	4.134	4.140	4.146	4.152	4.158	870
880	4.158	4.164	4.170	4.176	4.182	4.188	4.194	4.200	4.206	4.212	4.218	880
890	4.218	4.224	4.230	4.236	4.242	4.248	4.254	4.260	4.266	4.272	4.278	890
900	4.278	4.284	4.290	4.296	4.302	4.308	4.314	4.320	4.326	4.332	4.338	900
910	4.338	4.344	4.350	4.356	4.362	4.368	4.374	4.380	4.386	4.392	4.398	910
920	4.398	4.404	4.410	4.416	4.422	4.428	4.434	4.440	4.446	4.452	4.458	920
930	4.458	4.465	4.471	4.477	4.483	4.489	4.495	4.501	4.507	4.513	4.519	930
940	4.519	4.525	4.531	4.537	4.543	4.549	4.555	4.561	4.567	4.574	4.580	940
950	4.580	4.586	4.592	4.598	4.604	4.610	4.616	4.622	4.628	4.634	4.640	950
960	4.640	4.647	4.653	4.659	4.665	4.671	4.677	4.683	4.689	4.695	4.701	960
970	4.701	4.707	4.714	4.720	4.726	4.732	4.738	4.744	4.750	4.756	4.762	970
980	4.762	4.769	4.775	4.781	4.787	4.793	4.799	4.805	4.811	4.818	4.824	980
990	4.824	4.830	4.836	4.842	4.848	4.854	4.860	4.867	4.873	4.879	4.885	990
1,000	4.885	4.891	4.897	4.904	4.910	4.916	4.922	4.928	4.934	4.940	4.947	1,000
1,010	4.947	4.953	4.959	4.965	4.971	4.977	4.984	4.990	4.996	5.002	5.008	1,010
1,020	5.008	5.014	5.021	5.027	5.033	5.039	5.045	5.052	5.058	5.064	5.070	1,020
1,030	5.070	5.076	5.082	5.089	5.095	5.101	5.107	5.113	5.120	5.126	5.132	1,030
1,040	5.132	5.138	5.144	5.151	5.157	5.163	5.169	5.175	5.182	5.188	5.194	1,040
1,050	5.194	5.200	5.207	5.213	5.219	5.225	5.231	5.238	5.244	5.250	5.256	1,050
1,060	5.256	5.263	5.269	5.275	5.281	5.288	5.294	5.300	5.306	5.313	5.319	1,060
1,070	5.319	5.325	5.331	5.337	5.344	5.350	5.356	5.362	5.369	5.375	5.381	1,070
1,080	5.381	5.388	5.394	5.400	5.406	5.413	5.419	5.425	5.431	5.438	5.444	1,080
1,090	5.444	5.450	5.456	5.463	5.469	5.475	5.482	5.488	5.494	5.500	5.507	1,090
1,100	5.507	5.513	5.519	5.526	5.532	5.538	5.544	5.551	5.557	5.563	5.570	1,100
1,110	5.570	5.576	5.582	5.589	5.595	5.601	5.607	5.614	5.620	5.626	5.633	1,110
1,120	5.633	5.639	5.645	5.652	5.658	5.664	5.671	5.677	5.683	5.690	5.696	1,120
1,130	5.696	5.702	5.709	5.715	5.721	5.728	5.734	5.740	5.747	5.753	5.759	1,130
1,140	5.759	5.766	5.772	5.778	5.785	5.791	5.797	5.804	5.810	5.816	5.823	1,140
1,150	5.823	5.829	5.835	5.842	5.848	5.855	5.861	5.867	5.874	5.880	5.886	1,150
1,160	5.886	5.893	5.899	5.905	5.912	5.918	5.925	5.931	5.937	5.944	5.950	1,160
1,170	5.950	5.957	5.963	5.969	5.976	5.982	5.988	5.995	6.001	6.008	6.014	1,170
1,180	6.014	6.021	6.027	6.033	6.040	6.046	6.053	6.059	6.065	6.072	6.078	1,180
1,190	6.078	6.085	6.091	6.098	6.104	6.110	6.117	6.123	6.130	6.136	6.143	1,190
1,200	6.143	6.149	6.155	6.162	6.168	6.175	6.181	6.188	6.194	6.201	6.207	1,200

°F	0	1	2	3	4	5	6	7	8	9	10	°F
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TABLE A3.1.2. *Type R thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,200	6.143	6.149	6.155	6.162	6.168	6.175	6.181	6.188	6.194	6.201	6.207	1,200
1,210	6.207	6.213	6.220	6.226	6.233	6.239	6.246	6.252	6.259	6.265	6.272	1,210
1,220	6.272	6.278	6.285	6.291	6.297	6.304	6.310	6.317	6.323	6.330	6.336	1,220
1,230	6.336	6.343	6.349	6.356	6.362	6.369	6.375	6.382	6.388	6.395	6.401	1,230
1,240	6.401	6.408	6.414	6.421	6.427	6.434	6.440	6.447	6.453	6.460	6.466	1,240
1,250	6.466	6.473	6.479	6.486	6.492	6.499	6.505	6.512	6.518	6.525	6.532	1,250
1,260	6.532	6.538	6.545	6.551	6.558	6.564	6.571	6.577	6.584	6.590	6.597	1,260
1,270	6.597	6.603	6.610	6.616	6.623	6.630	6.636	6.643	6.649	6.656	6.662	1,270
1,280	6.662	6.669	6.675	6.682	6.689	6.695	6.702	6.708	6.715	6.721	6.728	1,280
1,290	6.728	6.735	6.741	6.748	6.754	6.761	6.767	6.774	6.781	6.787	6.794	1,290
1,300	6.794	6.800	6.807	6.814	6.820	6.827	6.833	6.840	6.847	6.853	6.860	1,300
1,310	6.860	6.866	6.873	6.880	6.886	6.893	6.899	6.906	6.913	6.919	6.926	1,310
1,320	6.926	6.932	6.939	6.946	6.952	6.959	6.966	6.972	6.979	6.985	6.992	1,320
1,330	6.992	6.999	7.005	7.012	7.019	7.025	7.032	7.039	7.045	7.052	7.059	1,330
1,340	7.059	7.065	7.072	7.078	7.085	7.092	7.098	7.105	7.112	7.118	7.125	1,340
1,350	7.125	7.132	7.138	7.145	7.152	7.158	7.165	7.172	7.178	7.185	7.192	1,350
1,360	7.192	7.198	7.205	7.212	7.218	7.225	7.232	7.239	7.245	7.252	7.259	1,360
1,370	7.259	7.265	7.272	7.279	7.285	7.292	7.299	7.305	7.312	7.319	7.326	1,370
1,380	7.326	7.332	7.339	7.346	7.352	7.359	7.366	7.373	7.379	7.386	7.393	1,380
1,390	7.393	7.399	7.406	7.413	7.420	7.426	7.433	7.440	7.447	7.453	7.460	1,390
1,400	7.460	7.467	7.474	7.480	7.487	7.494	7.500	7.507	7.514	7.521	7.527	1,400
1,410	7.527	7.534	7.541	7.548	7.554	7.561	7.568	7.575	7.582	7.588	7.595	1,410
1,420	7.595	7.602	7.609	7.615	7.622	7.629	7.636	7.642	7.649	7.656	7.663	1,420
1,430	7.663	7.670	7.676	7.683	7.690	7.697	7.703	7.710	7.717	7.724	7.731	1,430
1,440	7.731	7.737	7.744	7.751	7.758	7.765	7.771	7.778	7.785	7.792	7.799	1,440
1,450	7.799	7.805	7.812	7.819	7.826	7.833	7.840	7.846	7.853	7.860	7.867	1,450
1,460	7.867	7.874	7.880	7.887	7.894	7.901	7.908	7.915	7.921	7.928	7.935	1,460
1,470	7.935	7.942	7.949	7.956	7.963	7.969	7.976	7.983	7.990	7.997	8.004	1,470
1,480	8.004	8.010	8.017	8.024	8.031	8.038	8.045	8.052	8.058	8.065	8.072	1,480
1,490	8.072	8.079	8.086	8.093	8.100	8.107	8.113	8.120	8.127	8.134	8.141	1,490
1,500	8.141	8.148	8.155	8.162	8.168	8.175	8.182	8.189	8.196	8.203	8.210	1,500
1,510	8.210	8.217	8.224	8.231	8.237	8.244	8.251	8.258	8.265	8.272	8.279	1,510
1,520	8.279	8.286	8.293	8.300	8.306	8.313	8.320	8.327	8.334	8.341	8.348	1,520
1,530	8.348	8.355	8.362	8.369	8.376	8.383	8.390	8.397	8.403	8.410	8.417	1,530
1,540	8.417	8.424	8.431	8.438	8.445	8.452	8.459	8.466	8.473	8.480	8.487	1,540
1,550	8.487	8.494	8.501	8.508	8.515	8.522	8.529	8.535	8.542	8.549	8.556	1,550
1,560	8.556	8.563	8.570	8.577	8.584	8.591	8.598	8.605	8.612	8.619	8.626	1,560
1,570	8.626	8.633	8.640	8.647	8.654	8.661	8.668	8.675	8.682	8.689	8.696	1,570
1,580	8.696	8.703	8.710	8.717	8.724	8.731	8.738	8.745	8.752	8.759	8.766	1,580
1,590	8.766	8.773	8.780	8.787	8.794	8.801	8.808	8.815	8.822	8.829	8.836	1,590
1,600	8.836	8.843	8.850	8.857	8.864	8.871	8.878	8.885	8.892	8.899	8.907	1,600
1,610	8.907	8.914	8.921	8.928	8.935	8.942	8.949	8.956	8.963	8.970	8.977	1,610
1,620	8.977	8.984	8.991	8.998	9.005	9.012	9.019	9.026	9.033	9.040	9.048	1,620
1,630	9.048	9.055	9.062	9.069	9.076	9.083	9.090	9.097	9.104	9.111	9.118	1,630
1,640	9.118	9.125	9.132	9.140	9.147	9.154	9.161	9.168	9.175	9.182	9.189	1,640
1,650	9.189	9.196	9.203	9.210	9.218	9.225	9.232	9.239	9.246	9.253	9.260	1,650
1,660	9.260	9.267	9.274	9.282	9.289	9.296	9.303	9.310	9.317	9.324	9.331	1,660
1,670	9.331	9.338	9.346	9.353	9.360	9.367	9.374	9.381	9.388	9.395	9.403	1,670
1,680	9.403	9.410	9.417	9.424	9.431	9.438	9.445	9.453	9.460	9.467	9.474	1,680
1,690	9.474	9.481	9.488	9.495	9.503	9.510	9.517	9.524	9.531	9.538	9.546	1,690
1,700	9.546	9.553	9.560	9.567	9.574	9.581	9.589	9.596	9.603	9.610	9.617	1,700
1,710	9.617	9.624	9.632	9.639	9.646	9.653	9.660	9.668	9.675	9.682	9.689	1,710
1,720	9.689	9.696	9.704	9.711	9.718	9.725	9.732	9.740	9.747	9.754	9.761	1,720
1,730	9.761	9.768	9.776	9.783	9.790	9.797	9.804	9.812	9.819	9.826	9.833	1,730
1,740	9.833	9.840	9.848	9.855	9.862	9.869	9.877	9.884	9.891	9.898	9.906	1,740
1,750	9.906	9.913	9.920	9.927	9.934	9.942	9.949	9.956	9.963	9.971	9.978	1,750
1,760	9.978	9.985	9.992	10.000	10.007	10.014	10.021	10.029	10.036	10.043	10.050	1,760
1,770	10.050	10.058	10.065	10.072	10.079	10.087	10.094	10.101	10.109	10.116	10.123	1,770
1,780	10.123	10.130	10.138	10.145	10.152	10.159	10.167	10.174	10.181	10.189	10.196	1,780
1,790	10.196	10.203	10.210	10.218	10.225	10.232	10.240	10.247	10.254	10.262	10.269	1,790
1,800	10.269	10.276	10.283	10.291	10.298	10.305	10.313	10.320	10.327	10.335	10.342	1,800
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A3.1.2. Type R thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,800	10.269	10.276	10.283	10.291	10.298	10.305	10.313	10.320	10.327	10.335	10.342	1,800
1,810	10.342	10.349	10.357	10.364	10.371	10.379	10.386	10.393	10.400	10.408	10.415	1,810
1,820	10.415	10.422	10.430	10.437	10.444	10.452	10.459	10.466	10.474	10.481	10.488	1,820
1,830	10.488	10.496	10.503	10.511	10.518	10.525	10.533	10.540	10.547	10.555	10.562	1,830
1,840	10.562	10.569	10.577	10.584	10.591	10.599	10.606	10.613	10.621	10.628	10.636	1,840
1,850	10.636	10.643	10.650	10.658	10.665	10.672	10.680	10.687	10.695	10.702	10.709	1,850
1,860	10.709	10.717	10.724	10.731	10.739	10.746	10.754	10.761	10.768	10.776	10.783	1,860
1,870	10.783	10.791	10.798	10.805	10.813	10.820	10.828	10.835	10.842	10.850	10.857	1,870
1,880	10.857	10.865	10.872	10.879	10.887	10.894	10.902	10.909	10.917	10.924	10.931	1,880
1,890	10.931	10.939	10.946	10.954	10.961	10.968	10.976	10.983	10.991	10.998	11.006	1,890
1,900	11.006	11.013	11.021	11.028	11.035	11.043	11.050	11.058	11.065	11.073	11.080	1,900
1,910	11.080	11.088	11.095	11.102	11.110	11.117	11.125	11.132	11.140	11.147	11.155	1,910
1,920	11.155	11.162	11.170	11.177	11.184	11.192	11.199	11.207	11.214	11.222	11.229	1,920
1,930	11.229	11.237	11.244	11.252	11.259	11.267	11.274	11.282	11.289	11.297	11.304	1,930
1,940	11.304	11.312	11.319	11.327	11.334	11.342	11.349	11.357	11.364	11.372	11.379	1,940
1,950	11.379	11.387	11.394	11.402	11.409	11.417	11.424	11.432	11.439	11.447	11.454	1,950
1,960	11.454	11.462	11.469	11.477	11.484	11.492	11.499	11.507	11.514	11.522	11.529	1,960
1,970	11.529	11.537	11.544	11.552	11.559	11.567	11.574	11.582	11.590	11.597	11.605	1,970
1,980	11.605	11.612	11.620	11.627	11.635	11.642	11.650	11.657	11.665	11.672	11.680	1,980
1,990	11.680	11.688	11.695	11.703	11.710	11.718	11.725	11.733	11.740	11.748	11.756	1,990
2,000	11.756	11.763	11.771	11.778	11.786	11.793	11.801	11.808	11.816	11.824	11.831	2,000
2,010	11.831	11.839	11.846	11.854	11.861	11.869	11.877	11.884	11.892	11.899	11.907	2,010
2,020	11.907	11.914	11.922	11.930	11.937	11.945	11.952	11.960	11.968	11.975	11.983	2,020
2,030	11.983	11.990	11.998	12.005	12.013	12.021	12.028	12.036	12.043	12.051	12.059	2,030
2,040	12.059	12.066	12.074	12.081	12.089	12.097	12.104	12.112	12.119	12.127	12.135	2,040
2,050	12.135	12.142	12.150	12.157	12.165	12.173	12.180	12.188	12.196	12.203	12.211	2,050
2,060	12.211	12.218	12.226	12.234	12.241	12.249	12.257	12.264	12.272	12.279	12.287	2,060
2,070	12.287	12.295	12.302	12.310	12.318	12.325	12.333	12.340	12.348	12.356	12.363	2,070
2,080	12.363	12.371	12.379	12.386	12.394	12.402	12.409	12.417	12.424	12.432	12.440	2,080
2,090	12.440	12.447	12.455	12.463	12.470	12.478	12.486	12.493	12.501	12.509	12.516	2,090
2,100	12.516	12.524	12.532	12.539	12.547	12.555	12.562	12.570	12.577	12.585	12.593	2,100
2,110	12.593	12.600	12.608	12.616	12.623	12.631	12.639	12.646	12.654	12.662	12.669	2,110
2,120	12.669	12.677	12.685	12.693	12.700	12.708	12.716	12.723	12.731	12.739	12.746	2,120
2,130	12.746	12.754	12.762	12.769	12.777	12.785	12.792	12.800	12.808	12.815	12.823	2,130
2,140	12.823	12.831	12.838	12.846	12.854	12.862	12.869	12.877	12.885	12.892	12.900	2,140
2,150	12.900	12.908	12.915	12.923	12.931	12.938	12.946	12.954	12.962	12.969	12.977	2,150
2,160	12.977	12.985	12.992	13.000	13.008	13.016	13.023	13.031	13.039	13.046	13.054	2,160
2,170	13.054	13.062	13.069	13.077	13.085	13.093	13.100	13.108	13.116	13.123	13.131	2,170
2,180	13.131	13.139	13.147	13.154	13.162	13.170	13.178	13.185	13.193	13.201	13.208	2,180
2,190	13.208	13.216	13.224	13.232	13.239	13.247	13.255	13.263	13.270	13.278	13.286	2,190
2,200	13.286	13.293	13.301	13.309	13.317	13.324	13.332	13.340	13.348	13.355	13.363	2,200
2,210	13.363	13.371	13.379	13.386	13.394	13.402	13.409	13.417	13.425	13.433	13.440	2,210
2,220	13.440	13.448	13.456	13.464	13.471	13.479	13.487	13.495	13.502	13.510	13.518	2,220
2,230	13.518	13.526	13.533	13.541	13.549	13.557	13.564	13.572	13.580	13.588	13.595	2,230
2,240	13.595	13.603	13.611	13.619	13.627	13.634	13.642	13.650	13.658	13.665	13.673	2,240
2,250	13.673	13.681	13.689	13.696	13.704	13.712	13.720	13.727	13.735	13.743	13.751	2,250
2,260	13.751	13.759	13.766	13.774	13.782	13.790	13.797	13.805	13.813	13.821	13.828	2,260
2,270	13.828	13.836	13.844	13.852	13.860	13.867	13.875	13.883	13.891	13.898	13.906	2,270
2,280	13.906	13.914	13.922	13.930	13.937	13.945	13.953	13.961	13.968	13.976	13.984	2,280
2,290	13.984	13.992	14.000	14.007	14.015	14.023	14.031	14.039	14.046	14.054	14.062	2,290
2,300	14.062	14.070	14.078	14.085	14.093	14.101	14.109	14.116	14.124	14.132	14.140	2,300
2,310	14.140	14.148	14.155	14.163	14.171	14.179	14.187	14.194	14.202	14.210	14.218	2,310
2,320	14.218	14.226	14.233	14.241	14.249	14.257	14.265	14.272	14.280	14.288	14.296	2,320
2,330	14.296	14.304	14.311	14.319	14.327	14.335	14.343	14.350	14.358	14.366	14.374	2,330
2,340	14.374	14.382	14.389	14.397	14.405	14.413	14.421	14.429	14.436	14.444	14.452	2,340
2,350	14.452	14.460	14.468	14.475	14.483	14.491	14.499	14.507	14.514	14.522	14.530	2,350
2,360	14.530	14.538	14.546	14.554	14.561	14.569	14.577	14.585	14.593	14.600	14.608	2,360
2,370	14.608	14.616	14.624	14.632	14.640	14.647	14.655	14.663	14.671	14.679	14.686	2,370
2,380	14.686	14.694	14.702	14.710	14.718	14.726	14.733	14.741	14.749	14.757	14.765	2,380
2,390	14.765	14.772	14.780	14.788	14.796	14.804	14.812	14.819	14.827	14.835	14.843	2,390
2,400	14.843	14.851	14.859	14.866	14.874	14.882	14.890	14.898	14.906	14.913	14.921	2,400

°F	0	1	2	3	4	5	6	7	8	9	10	°F
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TABLE A3.1.2. Type R thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
2,400	14.843	14.851	14.859	14.866	14.874	14.882	14.890	14.898	14.906	14.913	14.921	2,400
2,410	14.921	14.929	14.937	14.945	14.953	14.960	14.968	14.976	14.984	14.992	15.000	2,410
2,420	15.000	15.007	15.015	15.023	15.031	15.039	15.047	15.054	15.062	15.070	15.078	2,420
2,430	15.078	15.086	15.094	15.101	15.109	15.117	15.125	15.133	15.141	15.148	15.156	2,430
2,440	15.156	15.164	15.172	15.180	15.188	15.195	15.203	15.211	15.219	15.227	15.235	2,440
2,450	15.235	15.242	15.250	15.258	15.266	15.274	15.282	15.289	15.297	15.305	15.313	2,450
2,460	15.313	15.321	15.329	15.337	15.344	15.352	15.360	15.368	15.376	15.384	15.391	2,460
2,470	15.391	15.399	15.407	15.415	15.423	15.431	15.438	15.446	15.454	15.462	15.470	2,470
2,480	15.470	15.478	15.486	15.493	15.501	15.509	15.517	15.525	15.533	15.540	15.548	2,480
2,490	15.548	15.556	15.564	15.572	15.580	15.587	15.595	15.603	15.611	15.619	15.627	2,490
2,500	15.627	15.635	15.642	15.650	15.658	15.666	15.674	15.682	15.689	15.697	15.705	2,500
2,510	15.705	15.713	15.721	15.729	15.737	15.744	15.752	15.760	15.768	15.776	15.784	2,510
2,520	15.784	15.791	15.799	15.807	15.815	15.823	15.831	15.839	15.846	15.854	15.862	2,520
2,530	15.862	15.870	15.878	15.886	15.893	15.901	15.909	15.917	15.925	15.933	15.941	2,530
2,540	15.941	15.948	15.956	15.964	15.972	15.980	15.988	15.995	16.003	16.011	16.019	2,540
2,550	16.019	16.027	16.035	16.043	16.050	16.058	16.066	16.074	16.082	16.090	16.097	2,550
2,560	16.097	16.105	16.113	16.121	16.129	16.137	16.145	16.152	16.160	16.168	16.176	2,560
2,570	16.176	16.184	16.192	16.199	16.207	16.215	16.223	16.231	16.239	16.247	16.254	2,570
2,580	16.254	16.262	16.270	16.278	16.286	16.294	16.301	16.309	16.317	16.325	16.333	2,580
2,590	16.333	16.341	16.349	16.356	16.364	16.372	16.380	16.388	16.396	16.403	16.411	2,590
2,600	16.411	16.419	16.427	16.435	16.443	16.450	16.458	16.466	16.474	16.482	16.490	2,600
2,610	16.490	16.498	16.505	16.513	16.521	16.529	16.537	16.545	16.552	16.560	16.568	2,610
2,620	16.568	16.576	16.584	16.592	16.599	16.607	16.615	16.623	16.631	16.639	16.646	2,620
2,630	16.646	16.654	16.662	16.670	16.678	16.686	16.694	16.701	16.709	16.717	16.725	2,630
2,640	16.725	16.733	16.741	16.748	16.756	16.764	16.772	16.780	16.788	16.795	16.803	2,640
2,650	16.803	16.811	16.819	16.827	16.835	16.842	16.850	16.858	16.866	16.874	16.882	2,650
2,660	16.882	16.889	16.897	16.905	16.913	16.921	16.929	16.936	16.944	16.952	16.960	2,660
2,670	16.960	16.968	16.976	16.983	16.991	16.999	17.007	17.015	17.022	17.030	17.038	2,670
2,680	17.038	17.046	17.054	17.062	17.069	17.077	17.085	17.093	17.101	17.109	17.116	2,680
2,690	17.116	17.124	17.132	17.140	17.148	17.156	17.163	17.171	17.179	17.187	17.195	2,690
2,700	17.195	17.202	17.210	17.218	17.226	17.234	17.242	17.249	17.257	17.265	17.273	2,700
2,710	17.273	17.281	17.288	17.296	17.304	17.312	17.320	17.328	17.335	17.343	17.351	2,710
2,720	17.351	17.359	17.367	17.374	17.382	17.390	17.398	17.406	17.413	17.421	17.429	2,720
2,730	17.429	17.437	17.445	17.453	17.460	17.468	17.476	17.484	17.492	17.499	17.507	2,730
2,740	17.507	17.515	17.523	17.531	17.538	17.546	17.554	17.562	17.570	17.577	17.585	2,740
2,750	17.585	17.593	17.601	17.609	17.616	17.624	17.632	17.640	17.648	17.655	17.663	2,750
2,760	17.663	17.671	17.679	17.687	17.694	17.702	17.710	17.718	17.726	17.733	17.741	2,760
2,770	17.741	17.749	17.757	17.765	17.772	17.780	17.788	17.796	17.804	17.811	17.819	2,770
2,780	17.819	17.827	17.835	17.842	17.850	17.858	17.866	17.874	17.881	17.889	17.897	2,780
2,790	17.897	17.905	17.913	17.920	17.928	17.936	17.944	17.951	17.959	17.967	17.975	2,790
2,800	17.975	17.983	17.990	17.998	18.006	18.014	18.021	18.029	18.037	18.045	18.053	2,800
2,810	18.053	18.060	18.068	18.076	18.084	18.091	18.099	18.107	18.115	18.123	18.130	2,810
2,820	18.130	18.138	18.146	18.154	18.161	18.169	18.177	18.185	18.192	18.200	18.208	2,820
2,830	18.208	18.216	18.223	18.231	18.239	18.247	18.255	18.262	18.270	18.278	18.286	2,830
2,840	18.286	18.293	18.301	18.309	18.317	18.324	18.332	18.340	18.348	18.355	18.363	2,840
2,850	18.363	18.371	18.379	18.386	18.394	18.402	18.410	18.417	18.425	18.433	18.441	2,850
2,860	18.441	18.448	18.456	18.464	18.472	18.479	18.487	18.495	18.502	18.510	18.518	2,860
2,870	18.518	18.526	18.533	18.541	18.549	18.557	18.564	18.572	18.580	18.588	18.595	2,870
2,880	18.595	18.603	18.611	18.619	18.626	18.634	18.642	18.649	18.657	18.665	18.673	2,880
2,890	18.673	18.680	18.688	18.696	18.703	18.711	18.719	18.727	18.734	18.742	18.750	2,890
2,900	18.750	18.758	18.765	18.773	18.781	18.788	18.796	18.804	18.812	18.819	18.827	2,900
2,910	18.827	18.835	18.842	18.850	18.858	18.865	18.873	18.881	18.889	18.896	18.904	2,910
2,920	18.904	18.912	18.919	18.927	18.935	18.943	18.950	18.958	18.966	18.973	18.981	2,920
2,930	18.981	18.989	18.996	19.004	19.012	19.019	19.027	19.035	19.043	19.050	19.058	2,930
2,940	19.058	19.066	19.073	19.081	19.089	19.096	19.104	19.112	19.119	19.127	19.135	2,940
2,950	19.135	19.142	19.150	19.158	19.165	19.173	19.181	19.188	19.196	19.204	19.211	2,950
2,960	19.211	19.219	19.227	19.234	19.242	19.250	19.257	19.265	19.273	19.280	19.288	2,960
2,970	19.288	19.296	19.303	19.311	19.319	19.326	19.334	19.342	19.349	19.357	19.365	2,970
2,980	19.365	19.372	19.380	19.388	19.395	19.403	19.411	19.418	19.426	19.434	19.441	2,980
2,990	19.441	19.449	19.457	19.464	19.472	19.479	19.487	19.495	19.502	19.510	19.518	2,990
3,000	19.518	19.525	19.533	19.541	19.548	19.556	19.563	19.571	19.579	19.586	19.594	3,000
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A3.1.2. *Type R thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
3,000	19.518	19.525	19.533	19.541	19.548	19.556	19.563	19.571	19.579	19.586	19.594	3,000
3,010	19.594	19.602	19.609	19.617	19.624	19.632	19.640	19.647	19.655	19.663	19.670	3,010
3,020	19.670	19.678	19.685	19.693	19.701	19.708	19.716	19.723	19.731	19.739	19.746	3,020
3,030	19.746	19.754	19.761	19.769	19.777	19.784	19.792	19.800	19.807	19.815	19.822	3,030
3,040	19.822	19.830	19.837	19.845	19.853	19.860	19.868	19.875	19.883	19.891	19.898	3,040
3,050	19.898	19.906	19.913	19.921	19.929	19.936	19.944	19.951	19.959	19.966	19.974	3,050
3,060	19.974	19.982	19.989	19.997	20.004	20.012	20.019	20.027	20.034	20.042	20.050	3,060
3,070	20.050	20.057	20.065	20.072	20.080	20.087	20.095	20.102	20.110	20.117	20.125	3,070
3,080	20.125	20.132	20.140	20.148	20.155	20.163	20.170	20.178	20.185	20.193	20.200	3,080
3,090	20.200	20.208	20.215	20.223	20.230	20.238	20.245	20.253	20.260	20.268	20.275	3,090
3,100	20.275	20.283	20.290	20.297	20.305	20.312	20.320	20.327	20.335	20.342	20.350	3,100
3,110	20.350	20.357	20.365	20.372	20.380	20.387	20.394	20.402	20.409	20.417	20.424	3,110
3,120	20.424	20.432	20.439	20.446	20.454	20.461	20.469	20.476	20.483	20.491	20.498	3,120
3,130	20.498	20.506	20.513	20.520	20.528	20.535	20.543	20.550	20.557	20.565	20.572	3,130
3,140	20.572	20.579	20.587	20.594	20.601	20.609	20.616	20.623	20.631	20.638	20.645	3,140
3,150	20.645	20.653	20.660	20.667	20.675	20.682	20.689	20.697	20.704	20.711	20.718	3,150
3,160	20.718	20.726	20.733	20.740	20.748	20.755	20.762	20.769	20.777	20.784	20.791	3,160
3,170	20.791	20.798	20.806	20.813	20.820	20.827	20.834	20.842	20.849	20.856	20.863	3,170
3,180	20.863	20.870	20.878	20.885	20.892	20.899	20.906	20.914	20.921	20.928	20.935	3,180
3,190	20.935	20.942	20.949	20.956	20.964	20.971	20.978	20.985	20.992	20.999	21.006	3,190
3,200	21.006	21.013	21.021	21.028	21.035	21.042	21.049	21.056	21.063	21.070	21.077	3,200
3,210	21.077	21.084	21.091	21.098	21.105							3,210
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A3.1.3. *Type R thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature ($^{\circ}\text{C}$) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius*

Temperature Range (°C)	a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (μV)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
- 50 to 900	.....	..	5.4295008	+0	1.1446885	-2	-1.1295306	-5	5.0020496	-9	-7 to 15
0 to 1100	.....	..	5.7622558	+0	9.2715271	-3	-7.1346883	-6	2.5877458	-9	-16 to 12
0 to 1400	.....	..	6.1429722	+0	7.1515857	-3	-3.7539447	-6	9.6963832	-10	-35 to 25
0 to 1650	.....	..	6.4615269	+0	5.7010917	-3	-1.8683292	-6	2.3636365	-10	-55 to 35
0 to 1768	.....	..	6.5962120	+0	5.1559203	-3	-1.2385309	-6	1.8827643	-11	-65 to 35
400 to 1100	-4.0674108	+2	8.7490294	+0	1.7115155	-3	7.5039035	-7	-3.0096280	-10	-.4 to .5
400 to 1400	-5.6047484	+2	9.6731111	+0	-2.6994046	-4	2.5536988	-6	-8.9155491	-10	-1.7 to 1.6
400 to 1650	-5.4505828	+2	9.5942872	+0	-1.2813352	-4	2.4468512	-6	-8.6286756	-10	-2.1 to 1.8
1050 to 1400	1.6618159	+3	2.3048526	+0	8.7635426	-3	-2.3016819	-6	7.4284923	-11	-.05 to .05
1050 to 1650	1.5132838	+3	2.7958847	+0	8.1571403	-3	-1.9701159	-6	6.5568964	-12	-.05 to .05
1400 to 1550	2.4008703	+3	4.1604579	-1	1.0549178	-2	-3.0383621	-6	1.8540516	-10	-.05 to .05
1400 to 1650	1.5787334	+3	2.6321144	+0	8.3100314	-3	-2.0332036	-6	1.6260416	-11	-.05 to .05
1400 to 1768	-7.1904948	+4	1.9442383	+2	-1.7913090	-1	7.9264764	-5	-1.3187245	-8	-1.0 to 1.3
1666 to 1768	8.8532076	+4	-1.5014129	+2	9.5376167	-2	-1.6644901	-5	-8.3062870	-10	-.05 to .05
II. Cubic Equation											
- 50 to 900	.....	..	6.0632060	+0	7.0729964	-3	-2.7461531	-6	.....	..	-30 to 60
0 to 1100	.....	..	6.4312595	+0	5.7063515	-3	-1.6171323	-6	.....	..	-51 to 31
0 to 1400	.....	..	6.6602336	+0	4.9866412	-3	-1.1222144	-6	.....	..	-70 to 35
0 to 1650	.....	..	6.6681844	+0	4.9675968	-3	-1.1120895	-6	.....	..	-70 to 40
0 to 1768	.....	..	6.6164788	+0	5.0888113	-3	-1.1739757	-6	.....	..	-65 to 40
400 to 1100	-3.3173012	+2	8.2968261	+0	2.6896906	-3	-1.5226719	-7	.....	..	-.6 to .8
400 to 1400	-1.4900615	+2	7.4755900	+0	3.8372620	-3	-6.5522906	-7	.....	..	-7 to 10
400 to 1650	7.0511331	+1	6.5679703	+0	4.9717004	-3	-1.0905912	-6	.....	..	-17 to 19
1050 to 1400	1.4980000	+3	2.8453533	+0	8.0970910	-3	-1.9377143	-6	.....	..	-.05 to .05
1050 to 1650	1.4925741	+3	2.8588183	+0	8.0860331	-3	-1.9347086	-6	.....	..	-.05 to .05
1400 to 1550	1.5265340	+3	2.7908769	+0	8.1313270	-3	-1.9447717	-6	.....	..	-.05 to .05
1400 to 1650	1.4915384	+3	2.8617020	+0	8.0835951	-3	-1.9340590	-6	.....	..	-.05 to .05
1400 to 1768	9.8946473	+3	-1.3614385	+1	1.8829682	-2	-4.2655016	-6	.....	..	-2 to 4
1666 to 1768	9.5736985	+4	-1.6693822	+2	1.1005861	-1	-2.2348111	-5	.....	..	-.05 to .05
Variable reference junction correction											
0 to 50	.....	..	5.2891411	+0	1.3844426	-2	-2.0889531	-5	.....	..	-0.01 to +0.01
III. Quadratic Equation											
- 50 to 900	.....	..	7.0091249	+0	3.6680622	-3	.....	..	.....	..	-100 to 120
0 to 1100	.....	..	7.2706944	+0	3.2499597	-3	.....	..	.....	..	-130 to 60
0 to 1400	.....	..	7.6038268	+0	2.8172081	-3	.....	..	.....	..	-160 to 90
0 to 1650	.....	..	7.9670282	+0	2.4339570	-3	.....	..	.....	..	-240 to 170
0 to 1768	.....	..	8.1907195	+0	2.2229871	-3	.....	..	.....	..	-330 to 230
400 to 1100	-3.8627420	+2	8.5408889	+0	2.3470378	-3	.....	..	.....	..	-3 to 2
400 to 1400	-5.2441977	+2	8.9543660	+0	2.0679233	-3	.....	..	.....	..	-31 to 25
400 to 1650	-8.0082944	+2	9.7098356	+0	1.6179512	-3	.....	..	.....	..	-95 to 75
1050 to 1400	-2.0139987	+3	1.1528256	+1	9.7566289	-4	.....	..	.....	..	-3.2 to 3.2
1050 to 1650	-3.1042936	+3	1.3315918	+1	2.5046320	-4	.....	..	.....	..	-16 to 16
1400 to 1550	-4.7053323	+3	1.5479630	+1	-4.7535391	-4	.....	..	.....	..	-.3 to .3
1400 to 1650	-5.3395443	+3	1.6339581	+1	-7.6649197	-4	.....	..	.....	..	-1.1 to 1.2
1400 to 1768	-6.9060256	+3	1.8401669	+1	-1.4430259	-3	.....	..	.....	..	-10 to 9
1666 to 1768	-1.7351473	+4	3.0715022	+1	-5.0686458	-3	.....	..	.....	..	-.9 to 1.0
Variable reference junction correction											
0 to 50	.....	..	5.3139863	+0	1.2244376	-2	.....	..	.....	..	-0.1 to +0.2

A3.2. Data for Temperature as a Function of Voltage

The temperature as a function of voltage data given in tables A3.2.1 and A3.2.2 were obtained by iteration in the primary equations for voltage as a function of temperature. Table A3.2.1 presents the data in millivolts from -0.22 mV to 21.10 mV with temperatures given in degrees Celsius while table A3.2.2 presents similar data with temperatures in degrees Fahrenheit. Table A3.2.3 contains quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges. The error range given in the table represents the difference between the temperature found by iteration in the full precision tables from the text and from the respective reduced order approximations.

TABLE A3.2.1. *Type R thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPITS 1968)												
-0.20	-43.08	-45.65	-48.27									-0.20
-0.10	-20.00	-22.14	-24.31	-26.52	-28.76	-31.04	-33.35	-35.71	-38.12	-40.58	-43.08	-0.10
-0.00	0.00	-1.90	-3.82	-5.76	-7.72	-9.71	-11.71	-13.74	-15.80	-17.88	-20.00	-0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A3.2.1. *Type R thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
0.00	0.00	1.88	3.74	5.59	7.42	9.23	11.03	12.81	14.58	16.33	18.07	0.00
0.10	18.07	19.80	21.51	23.22	24.91	26.58	28.25	29.91	31.55	33.18	34.81	0.10
0.20	34.81	36.42	38.03	39.62	41.21	42.79	44.35	45.91	47.47	49.01	50.54	0.20
0.30	50.54	52.07	53.59	55.11	56.61	58.11	59.60	61.09	62.56	64.04	65.50	0.30
0.40	65.50	66.96	68.41	69.86	71.30	72.74	74.17	75.59	77.01	78.42	79.83	0.40
0.50	79.83	81.23	82.63	84.02	85.41	86.79	88.17	89.54	90.91	92.28	93.64	0.50
0.60	93.64	94.99	96.34	97.69	99.03	100.37	101.70	103.04	104.36	105.68	107.00	0.60
0.70	107.00	108.32	109.63	110.94	112.24	113.54	114.84	116.13	117.42	118.71	119.99	0.70
0.80	119.99	121.28	122.55	123.83	125.10	126.37	127.63	128.89	130.15	131.41	132.66	0.80
0.90	132.66	133.91	135.16	136.40	137.64	138.88	140.12	141.35	142.58	143.81	145.04	0.90
1.00	145.04	146.26	147.48	148.70	149.91	151.13	152.34	153.55	154.75	155.96	157.16	1.00
1.10	157.16	158.36	159.56	160.75	161.94	163.13	164.32	165.51	166.69	167.88	169.06	1.10
1.20	169.06	170.23	171.41	172.58	173.76	174.93	176.09	177.26	178.43	179.59	180.75	1.20
1.30	180.75	181.91	183.06	184.22	185.37	186.52	187.67	188.82	189.97	191.11	192.26	1.30
1.40	192.26	193.40	194.54	195.68	196.81	197.95	199.08	200.21	201.34	202.47	203.60	1.40
1.50	203.60	204.72	205.85	206.97	208.09	209.21	210.33	211.44	212.56	213.67	214.78	1.50
1.60	214.78	215.89	217.00	218.11	219.22	220.32	221.43	222.53	223.63	224.73	225.83	1.60
1.70	225.83	226.93	228.02	229.12	230.21	231.30	232.39	233.48	234.57	235.66	236.75	1.70
1.80	236.75	237.83	238.91	240.00	241.08	242.16	243.24	244.31	245.39	246.47	247.54	1.80
1.90	247.54	248.61	249.69	250.76	251.83	252.90	253.97	255.03	256.10	257.16	258.23	1.90
2.00	258.23	259.29	260.35	261.41	262.47	263.53	264.59	265.64	266.70	267.75	268.81	2.00
2.10	268.81	269.86	270.91	271.96	273.01	274.06	275.11	276.16	277.20	278.25	279.29	2.10
2.20	279.29	280.34	281.38	282.42	283.46	284.50	285.54	286.58	287.61	288.65	289.69	2.20
2.30	289.69	290.72	291.75	292.79	293.82	294.85	295.88	296.91	297.94	298.97	300.00	2.30
2.40	300.00	301.02	302.05	303.07	304.10	305.12	306.14	307.16	308.18	309.20	310.22	2.40
2.50	310.22	311.24	312.26	313.28	314.29	315.31	316.32	317.34	318.35	319.37	320.38	2.50
2.60	320.38	321.39	322.40	323.41	324.42	325.43	326.44	327.44	328.45	329.45	330.46	2.60
2.70	330.46	331.46	332.47	333.47	334.47	335.47	336.48	337.48	338.48	339.48	340.47	2.70
2.80	340.47	341.47	342.47	343.47	344.46	345.46	346.45	347.45	348.44	349.43	350.42	2.80
2.90	350.42	351.42	352.41	353.40	354.39	355.38	356.36	357.35	358.34	359.33	360.31	2.90
3.00	360.31	361.30	362.28	363.27	364.25	365.23	366.22	367.20	368.18	369.16	370.14	3.00
3.10	370.14	371.12	372.10	373.08	374.06	375.04	376.01	376.99	377.97	378.94	379.92	3.10
3.20	379.92	380.89	381.87	382.84	383.81	384.78	385.76	386.73	387.70	388.67	389.64	3.20
3.30	389.64	390.61	391.58	392.54	393.51	394.48	395.45	396.41	397.38	398.34	399.31	3.30
3.40	399.31	400.27	401.23	402.20	403.16	404.12	405.08	406.05	407.01	407.97	408.93	3.40
3.50	408.93	409.89	410.84	411.80	412.76	413.72	414.67	415.63	416.59	417.54	418.50	3.50
3.60	418.50	419.45	420.41	421.36	422.31	423.27	424.22	425.17	426.12	427.07	428.02	3.60
3.70	428.02	428.97	429.92	430.87	431.82	432.77	433.72	434.66	435.61	436.56	437.50	3.70
3.80	437.50	438.45	439.39	440.34	441.28	442.23	443.17	444.11	445.06	446.00	446.94	3.80
3.90	446.94	447.88	448.82	449.76	450.70	451.64	452.58	453.52	454.46	455.40	456.33	3.90
4.00	456.33	457.27	458.21	459.14	460.08	461.02	461.95	462.89	463.82	464.75	465.69	4.00
4.10	465.69	466.62	467.55	468.49	469.42	470.35	471.28	472.21	473.14	474.07	475.00	4.10
4.20	475.00	475.93	476.86	477.79	478.71	479.64	480.57	481.50	482.42	483.35	484.27	4.20
4.30	484.27	485.20	486.12	487.05	487.97	488.90	489.82	490.74	491.66	492.59	493.51	4.30
4.40	493.51	494.43	495.35	496.27	497.19	498.11	499.03	499.95	500.87	501.79	502.70	4.40
4.50	502.70	503.62	504.54	505.46	506.37	507.29	508.20	509.12	510.04	510.95	511.86	4.50
4.60	511.86	512.78	513.69	514.61	515.52	516.43	517.34	518.25	519.17	520.08	520.99	4.60
4.70	520.99	521.90	522.81	523.72	524.63	525.54	526.44	527.35	528.26	529.17	530.08	4.70
4.80	530.08	530.98	531.89	532.79	533.70	534.61	535.51	536.42	537.32	538.22	539.13	4.80
4.90	539.13	540.03	540.93	541.84	542.74	543.64	544.54	545.44	546.34	547.25	548.15	4.90
5.00	548.15	549.05	549.95	550.84	551.74	552.64	553.54	554.44	555.34	556.23	557.13	5.00
5.10	557.13	558.03	558.92	559.82	560.71	561.61	562.50	563.40	564.29	565.19	566.08	5.10
5.20	566.08	566.97	567.87	568.76	569.65	570.54	571.44	572.33	573.22	574.11	575.00	5.20
5.30	575.00	575.89	576.78	577.67	578.56	579.45	580.33	581.22	582.11	583.00	583.88	5.30
5.40	583.88	584.77	585.66	586.54	587.43	588.32	589.20	590.09	590.97	591.85	592.74	5.40
5.50	592.74	593.62	594.51	595.39	596.27	597.15	598.04	598.92	599.80	600.68	601.56	5.50
5.60	601.56	602.44	603.32	604.20	605.08	605.96	606.84	607.72	608.60	609.48	610.36	5.60
5.70	610.36	611.23	612.11	612.99	613.87	614.74	615.62	616.49	617.37	618.25	619.12	5.70
5.80	619.12	620.00	620.88	621.74	622.62	623.49	624.37	625.24	626.11	626.98	627.86	5.80
5.90	627.86	628.73	629.60	630.47	631.34	632.21	633.08	633.95	634.82	635.69	636.55	5.90
6.00	636.55	637.42	638.29	639.16	640.02	640.89	641.75	642.62	643.48	644.35	645.21	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A3.2.1. Type R thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
6.00	636.55	637.42	638.29	639.16	640.02	640.89	641.75	642.62	643.48	644.35	645.21	6.00
6.10	645.21	646.08	646.94	647.81	648.67	649.53	650.39	651.26	652.12	652.98	653.84	6.10
6.20	653.84	654.70	655.56	656.42	657.28	658.14	659.00	659.86	660.72	661.58	662.44	6.20
6.30	662.44	663.30	664.15	665.01	665.87	666.73	667.58	668.44	669.29	670.15	671.00	6.30
6.40	671.00	671.86	672.71	673.57	674.42	675.28	676.13	676.98	677.84	678.69	679.54	6.40
6.50	679.54	680.39	681.24	682.09	682.95	683.80	684.65	685.50	686.35	687.20	688.04	6.50
6.60	688.04	688.89	689.74	690.59	691.44	692.29	693.13	693.98	694.83	695.67	696.52	6.60
6.70	696.52	697.37	698.21	699.06	699.90	700.75	701.59	702.43	703.28	704.12	704.97	6.70
6.80	704.97	705.81	706.65	707.49	708.34	709.18	710.02	710.86	711.70	712.54	713.38	6.80
6.90	713.38	714.22	715.06	715.90	716.74	717.58	718.42	719.26	720.09	720.93	721.77	6.90
7.00	721.77	722.61	723.44	724.28	725.12	725.95	726.79	727.63	728.46	729.30	730.13	7.00
7.10	730.13	730.96	731.80	732.63	733.47	734.30	735.13	735.97	736.80	737.63	738.46	7.10
7.20	738.46	739.29	740.13	740.96	741.79	742.62	743.45	744.28	745.11	745.94	746.77	7.20
7.30	746.77	747.60	748.42	749.25	750.08	750.91	751.74	752.56	753.39	754.22	755.04	7.30
7.40	755.04	755.87	756.70	757.52	758.35	759.17	760.00	760.82	761.65	762.47	763.29	7.40
7.50	763.29	764.12	764.94	765.76	766.59	767.41	768.23	769.05	769.87	770.70	771.52	7.50
7.60	771.52	772.34	773.16	773.98	774.80	775.62	776.44	777.26	778.08	778.90	779.71	7.60
7.70	779.71	780.53	781.35	782.17	782.99	783.80	784.62	785.44	786.25	787.07	787.89	7.70
7.80	787.89	788.70	789.52	790.33	791.15	791.96	792.78	793.59	794.41	795.22	796.03	7.80
7.90	796.03	796.85	797.66	798.47	799.28	800.10	800.91	801.72	802.53	803.34	804.15	7.90
8.00	804.15	804.96	805.77	806.58	807.39	808.20	809.01	809.82	810.63	811.44	812.25	8.00
8.10	812.25	813.06	813.87	814.67	815.48	816.29	817.09	817.90	818.71	819.51	820.32	8.10
8.20	820.32	821.13	821.93	822.74	823.54	824.35	825.15	825.96	826.76	827.56	828.37	8.20
8.30	828.37	829.17	829.97	830.78	831.58	832.38	833.18	833.99	834.79	835.59	836.39	8.30
8.40	836.39	837.19	837.99	838.79	839.59	840.39	841.19	841.99	842.79	843.59	844.39	8.40
8.50	844.39	845.19	845.99	846.78	847.58	848.38	849.18	849.97	850.77	851.57	852.36	8.50
8.60	852.36	853.16	853.96	854.75	855.55	856.34	857.14	857.93	858.73	859.52	860.32	8.60
8.70	860.32	861.11	861.90	862.70	863.49	864.28	865.08	865.87	866.66	867.45	868.25	8.70
8.80	868.25	869.04	869.83	870.62	871.41	872.20	872.99	873.78	874.57	875.36	876.15	8.80
8.90	876.15	876.94	877.73	878.52	879.31	880.10	880.89	881.67	882.46	883.25	884.04	8.90
9.00	884.04	884.82	885.61	886.40	887.18	887.97	888.76	889.54	890.33	891.11	891.90	9.00
9.10	891.90	892.68	893.47	894.25	895.04	895.82	896.60	897.39	898.17	898.95	899.74	9.10
9.20	899.74	900.52	901.30	902.09	902.87	903.65	904.43	905.21	905.99	906.77	907.56	9.20
9.30	907.56	908.34	909.12	909.90	910.68	911.46	912.24	913.02	913.79	914.57	915.35	9.30
9.40	915.35	916.13	916.91	917.69	918.47	919.24	920.02	920.80	921.57	922.35	923.13	9.40
9.50	923.13	923.90	924.68	925.46	926.23	927.01	927.78	928.56	929.33	930.11	930.88	9.50
9.60	930.88	931.66	932.43	933.20	933.98	934.75	935.52	936.30	937.07	937.84	938.62	9.60
9.70	938.62	939.39	940.16	940.93	941.70	942.47	943.25	944.02	944.79	945.56	946.33	9.70
9.80	946.33	947.10	947.87	948.64	949.41	950.18	950.95	951.72	952.48	953.25	954.02	9.80
9.90	954.02	954.79	955.56	956.32	957.09	957.86	958.63	959.39	960.16	960.93	961.69	9.90
10.00	961.69	962.46	963.23	963.99	964.76	965.52	966.29	967.05	967.82	968.58	969.35	10.00
10.10	969.35	970.11	970.87	971.64	972.40	973.16	973.93	974.69	975.45	976.22	976.98	10.10
10.20	976.98	977.74	978.50	979.26	980.03	980.79	981.55	982.31	983.07	983.83	984.59	10.20
10.30	984.59	985.35	986.11	986.87	987.63	988.39	989.15	989.91	990.67	991.43	992.19	10.30
10.40	992.19	992.94	993.70	994.46	995.22	995.98	996.73	997.49	998.25	999.00	999.76	10.40
10.50	999.76	1000.52	1001.27	1002.03	1002.79	1003.54	1004.30	1005.05	1005.81	1006.56	1007.32	10.50
10.60	1007.32	1008.07	1008.83	1009.58	1010.33	1011.09	1011.84	1012.60	1013.35	1014.10	1014.85	10.60
10.70	1014.85	1015.61	1016.36	1017.11	1017.86	1018.62	1019.37	1020.12	1020.87	1021.62	1022.37	10.70
10.80	1022.37	1023.12	1023.87	1024.63	1025.38	1026.13	1026.88	1027.63	1028.38	1029.12	1029.87	10.80
10.90	1029.87	1030.62	1031.37	1032.12	1032.87	1033.62	1034.37	1035.11	1035.86	1036.61	1037.36	10.90
11.00	1037.36	1038.10	1038.85	1039.60	1040.34	1041.09	1041.84	1042.58	1043.33	1044.07	1044.82	11.00
11.10	1044.82	1045.57	1046.31	1047.06	1047.80	1048.55	1049.29	1050.03	1050.78	1051.52	1052.27	11.10
11.20	1052.27	1053.01	1053.75	1054.50	1055.24	1055.98	1056.73	1057.47	1058.21	1058.95	1059.70	11.20
11.30	1059.70	1060.44	1061.18	1061.92	1062.66	1063.40	1064.14	1064.89	1065.63	1066.37	1067.11	11.30
11.40	1067.11	1067.85	1068.59	1069.33	1070.07	1070.81	1071.55	1072.29	1073.03	1073.76	1074.50	11.40
11.50	1074.50	1075.24	1075.98	1076.72	1077.46	1078.20	1078.93	1079.67	1080.41	1081.15	1081.88	11.50
11.60	1081.88	1082.62	1083.36	1084.10	1084.83	1085.57	1086.31	1087.04	1087.78	1088.51	1089.25	11.60
11.70	1089.25	1089.99	1090.72	1091.46	1092.19	1092.93	1093.66	1094.40	1095.13	1095.87	1096.60	11.70
11.80	1096.60	1097.34	1098.07	1098.81	1099.54	1100.27	1101.01	1101.74	1102.48	1103.21	1103.94	11.80
11.90	1103.94	1104.68	1105.41	1106.14	1106.87	1107.61	1108.34	1109.07	1109.80	1110.54	1111.27	11.90
12.00	1111.27	1112.00	1112.73	1113.46	1114.19	1114.93	1115.66	1116.39	1117.12	1117.85	1118.58	12.00

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
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TABLE A3.2.1. *Type R thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
12.00	1111.27	1112.00	1112.73	1113.46	1114.19	1114.93	1115.66	1116.39	1117.12	1117.85	1118.58	12.00
12.10	1118.58	1119.31	1120.04	1120.77	1121.50	1122.23	1122.96	1123.69	1124.42	1125.15	1125.88	12.10
12.20	1125.88	1126.61	1127.34	1128.07	1128.80	1129.53	1130.25	1130.98	1131.71	1132.44	1133.17	12.20
12.30	1133.17	1133.90	1134.63	1135.35	1136.08	1136.81	1137.54	1138.26	1138.99	1139.72	1140.45	12.30
12.40	1140.45	1141.17	1141.90	1142.63	1143.35	1144.08	1144.81	1145.53	1146.26	1146.98	1147.71	12.40
12.50	1147.71	1148.44	1149.16	1149.89	1150.61	1151.34	1152.06	1152.79	1153.52	1154.24	1154.97	12.50
12.60	1154.97	1155.69	1156.41	1157.14	1157.86	1158.59	1159.31	1160.04	1160.76	1161.49	1162.21	12.60
12.70	1162.21	1162.93	1163.66	1164.38	1165.10	1165.83	1166.55	1167.27	1168.00	1168.72	1169.44	12.70
12.80	1169.44	1170.17	1170.89	1171.61	1172.33	1173.06	1173.78	1174.50	1175.22	1175.94	1176.67	12.80
12.90	1176.67	1177.39	1178.11	1178.83	1179.55	1180.28	1181.00	1181.72	1182.44	1183.16	1183.88	12.90
13.00	1183.88	1184.60	1185.32	1186.04	1186.76	1187.49	1188.21	1188.93	1189.65	1190.37	1191.09	13.00
13.10	1191.09	1191.81	1192.53	1193.25	1193.97	1194.69	1195.41	1196.13	1196.84	1197.56	1198.28	13.10
13.20	1198.28	1199.00	1199.72	1200.44	1201.16	1201.88	1202.60	1203.32	1204.04	1204.75	1205.47	13.20
13.30	1205.47	1206.19	1206.91	1207.63	1208.34	1209.06	1209.78	1210.50	1211.22	1211.93	1212.65	13.30
13.40	1212.65	1213.37	1214.09	1214.80	1215.52	1216.24	1216.96	1217.67	1218.39	1219.11	1219.82	13.40
13.50	1219.82	1220.54	1221.26	1221.97	1222.69	1223.41	1224.12	1224.84	1225.56	1226.27	1226.99	13.50
13.60	1226.99	1227.71	1228.42	1229.14	1229.85	1230.57	1231.29	1232.00	1232.72	1233.43	1234.15	13.60
13.70	1234.15	1234.86	1235.58	1236.29	1237.01	1237.72	1238.44	1239.15	1239.87	1240.58	1241.30	13.70
13.80	1241.30	1242.01	1242.73	1243.44	1244.16	1244.87	1245.59	1246.30	1247.01	1247.73	1248.44	13.80
13.90	1248.44	1249.16	1249.87	1250.59	1251.30	1252.01	1252.73	1253.44	1254.15	1254.87	1255.58	13.90
14.00	1255.58	1256.30	1257.01	1257.72	1258.44	1259.15	1259.86	1260.58	1261.29	1262.00	1262.71	14.00
14.10	1262.71	1263.43	1264.14	1264.85	1265.57	1266.28	1266.99	1267.70	1268.42	1269.13	1269.84	14.10
14.20	1269.84	1270.55	1271.27	1271.98	1272.69	1273.40	1274.12	1274.83	1275.54	1276.25	1276.96	14.20
14.30	1276.96	1277.68	1278.39	1279.10	1279.81	1280.52	1281.24	1281.95	1282.66	1283.37	1284.08	14.30
14.40	1284.08	1284.79	1285.50	1286.22	1286.93	1287.64	1288.35	1289.06	1289.77	1290.48	1291.19	14.40
14.50	1291.19	1291.91	1292.62	1293.33	1294.04	1294.75	1295.46	1296.17	1296.88	1297.59	1298.30	14.50
14.60	1298.30	1299.01	1299.72	1300.43	1301.15	1301.86	1302.57	1303.28	1303.99	1304.70	1305.41	14.60
14.70	1305.41	1306.12	1306.83	1307.54	1308.25	1308.96	1309.67	1310.38	1311.09	1311.80	1312.51	14.70
14.80	1312.51	1313.22	1313.93	1314.64	1315.35	1316.06	1316.77	1317.48	1318.19	1318.90	1319.61	14.80
14.90	1319.61	1320.32	1321.03	1321.73	1322.44	1323.15	1323.86	1324.57	1325.28	1325.99	1326.70	14.90
15.00	1326.70	1327.41	1328.12	1328.83	1329.54	1330.25	1330.96	1331.66	1332.37	1333.08	1333.79	15.00
15.10	1333.79	1334.50	1335.21	1335.92	1336.63	1337.34	1338.05	1338.75	1339.46	1340.17	1340.88	15.10
15.20	1340.88	1341.59	1342.30	1343.01	1343.72	1344.43	1345.13	1345.84	1346.55	1347.26	1347.97	15.20
15.30	1347.97	1348.68	1349.39	1350.09	1350.80	1351.51	1352.22	1352.93	1353.64	1354.35	1355.05	15.30
15.40	1355.05	1355.76	1356.47	1357.18	1357.89	1358.60	1359.30	1360.01	1360.72	1361.43	1362.14	15.40
15.50	1362.14	1362.85	1363.55	1364.26	1364.97	1365.68	1366.39	1367.10	1367.80	1368.51	1369.22	15.50
15.60	1369.22	1369.93	1370.64	1371.34	1372.05	1372.76	1373.47	1374.18	1374.89	1375.59	1376.30	15.60
15.70	1376.30	1377.01	1377.72	1378.43	1379.13	1379.84	1380.55	1381.26	1381.97	1382.67	1383.38	15.70
15.80	1383.38	1384.09	1384.80	1385.51	1386.21	1386.92	1387.63	1388.34	1389.05	1389.75	1390.46	15.80
15.90	1390.46	1391.17	1391.88	1392.59	1393.29	1394.00	1394.71	1395.42	1396.13	1396.83	1397.54	15.90
16.00	1397.54	1398.25	1398.96	1399.67	1400.37	1401.08	1401.79	1402.50	1403.21	1403.92	1404.62	16.00
16.10	1404.62	1405.33	1406.04	1406.75	1407.46	1408.16	1408.87	1409.58	1410.29	1411.00	1411.70	16.10
16.20	1411.70	1412.41	1413.12	1413.83	1414.54	1415.24	1415.95	1416.66	1417.37	1418.08	1418.79	16.20
16.30	1418.79	1419.49	1420.20	1420.91	1421.62	1422.33	1423.04	1423.74	1424.45	1425.16	1425.87	16.30
16.40	1425.87	1426.58	1427.29	1427.99	1428.70	1429.41	1430.12	1430.83	1431.54	1432.24	1432.95	16.40
16.50	1432.95	1433.66	1434.37	1435.08	1435.79	1436.50	1437.20	1437.91	1438.62	1439.33	1440.04	16.50
16.60	1440.04	1440.75	1441.46	1442.16	1442.87	1443.58	1444.29	1445.00	1445.71	1446.42	1447.13	16.60
16.70	1447.13	1447.83	1448.54	1449.25	1449.96	1450.67	1451.38	1452.09	1452.80	1453.51	1454.22	16.70
16.80	1454.22	1454.92	1455.63	1456.34	1457.05	1457.76	1458.47	1459.18	1459.89	1460.60	1461.31	16.80
16.90	1461.31	1462.02	1462.73	1463.44	1464.15	1464.86	1465.56	1466.27	1466.98	1467.69	1468.40	16.90
17.00	1468.40	1469.11	1469.82	1470.53	1471.24	1471.95	1472.66	1473.37	1474.08	1474.79	1475.50	17.00
17.10	1475.50	1476.21	1476.92	1477.63	1478.34	1479.05	1479.76	1480.47	1481.18	1481.89	1482.60	17.10
17.20	1482.60	1483.31	1484.02	1484.73	1485.45	1486.16	1486.87	1487.58	1488.29	1489.00	1489.71	17.20
17.30	1489.71	1490.42	1491.13	1491.84	1492.55	1493.26	1493.97	1494.68	1495.39	1496.10	1496.81	17.30
17.40	1496.81	1497.53	1498.24	1498.95	1499.66	1500.37	1501.09	1501.80	1502.51	1503.22	1503.93	17.40
17.50	1503.93	1504.64	1505.36	1506.07	1506.78	1507.49	1508.20	1508.91	1509.63	1510.34	1511.05	17.50
17.60	1511.05	1511.76	1512.48	1513.19	1513.90	1514.61	1515.32	1516.04	1516.75	1517.46	1518.17	17.60
17.70	1518.17	1518.89	1519.60	1520.31	1521.02	1521.74	1522.45	1523.16	1523.88	1524.59	1525.30	17.70
17.80	1525.30	1526.02	1526.73	1527.44	1528.16	1528.87	1529.58	1530.30	1531.01	1531.72	1532.44	17.80
17.90	1532.44	1533.15	1533.86	1534.58	1535.29	1536.01	1536.72	1537.43	1538.15	1538.86	1539.58	17.90
18.00	1539.58	1540.29	1541.01	1541.72	1542.43	1543.15	1543.86	1544.58	1545.29	1546.01	1546.72	18.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A3.2.1. *Type R thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
18.00	1539.58	1540.29	1541.01	1541.72	1542.43	1543.15	1543.86	1544.58	1545.29	1546.01	1546.72	18.00
18.10	1546.72	1547.44	1548.15	1548.87	1549.58	1550.30	1551.01	1551.73	1552.45	1553.16	1553.88	18.10
18.20	1553.88	1554.59	1555.31	1556.02	1556.74	1557.46	1558.17	1558.89	1559.60	1560.32	1561.04	18.20
18.30	1561.04	1561.75	1562.47	1563.19	1563.90	1564.62	1565.34	1566.05	1566.77	1567.49	1568.20	18.30
18.40	1568.20	1568.92	1569.64	1570.35	1571.07	1571.79	1572.51	1573.22	1573.94	1574.66	1575.38	18.40
18.50	1575.38	1576.09	1576.81	1577.53	1578.25	1578.97	1579.69	1580.40	1581.12	1581.84	1582.56	18.50
18.60	1582.56	1583.28	1584.00	1584.72	1585.43	1586.15	1586.87	1587.59	1588.31	1589.03	1589.75	18.60
18.70	1589.75	1590.47	1591.19	1591.91	1592.63	1593.35	1594.07	1594.79	1595.51	1596.23	1596.95	18.70
18.80	1596.95	1597.67	1598.39	1599.11	1599.83	1600.55	1601.27	1601.99	1602.71	1603.43	1604.16	18.80
18.90	1604.16	1604.88	1605.60	1606.32	1607.04	1607.76	1608.48	1609.21	1609.93	1610.65	1611.37	18.90
19.00	1611.37	1612.09	1612.82	1613.54	1614.26	1614.98	1615.71	1616.43	1617.15	1617.88	1618.60	19.00
19.10	1618.60	1619.32	1620.05	1620.77	1621.49	1622.22	1622.94	1623.66	1624.39	1625.11	1625.84	19.10
19.20	1625.84	1626.56	1627.28	1628.01	1628.73	1629.46	1630.18	1630.91	1631.63	1632.36	1633.08	19.20
19.30	1633.08	1633.81	1634.53	1635.26	1635.98	1636.71	1637.43	1638.16	1638.89	1639.61	1640.34	19.30
19.40	1640.34	1641.06	1641.79	1642.52	1643.24	1643.97	1644.70	1645.43	1646.15	1646.88	1647.61	19.40
19.50	1647.61	1648.33	1649.06	1649.79	1650.52	1651.24	1651.97	1652.70	1653.43	1654.16	1654.89	19.50
19.60	1654.89	1655.61	1656.34	1657.07	1657.80	1658.53	1659.26	1659.99	1660.72	1661.45	1662.18	19.60
19.70	1662.18	1662.91	1663.64	1664.37	1665.10	1665.83	1666.56	1667.29	1668.02	1668.75	1669.48	19.70
19.80	1669.48	1670.21	1670.94	1671.67	1672.41	1673.14	1673.87	1674.60	1675.33	1676.07	1676.80	19.80
19.90	1676.80	1677.53	1678.26	1679.00	1679.73	1680.46	1681.20	1681.93	1682.67	1683.40	1684.14	19.90
20.00	1684.14	1684.87	1685.61	1686.34	1687.08	1687.81	1688.55	1689.28	1690.02	1690.76	1691.50	20.00
20.10	1691.50	1692.23	1692.97	1693.71	1694.45	1695.18	1695.92	1696.66	1697.40	1698.14	1698.88	20.10
20.20	1698.88	1699.62	1700.36	1701.10	1701.84	1702.59	1703.33	1704.07	1704.81	1705.56	1706.30	20.20
20.30	1706.30	1707.04	1707.79	1708.53	1709.28	1710.02	1710.77	1711.51	1712.26	1713.00	1713.75	20.30
20.40	1713.75	1714.50	1715.25	1716.00	1716.74	1717.49	1718.24	1718.99	1719.74	1720.49	1721.25	20.40
20.50	1721.25	1722.00	1722.75	1723.50	1724.26	1725.01	1725.76	1726.52	1727.27	1728.03	1728.78	20.50
20.60	1728.78	1729.54	1730.30	1731.06	1731.81	1732.57	1733.33	1734.09	1734.85	1735.61	1736.37	20.60
20.70	1736.37	1737.14	1737.90	1738.66	1739.42	1740.19	1740.95	1741.72	1742.49	1743.25	1744.02	20.70
20.80	1744.02	1744.79	1745.56	1746.32	1747.09	1747.86	1748.64	1749.41	1750.18	1750.95	1751.73	20.80
20.90	1751.73	1752.50	1753.28	1754.05	1754.83	1755.61	1756.38	1757.16	1757.94	1758.72	1759.50	20.90
21.00	1759.50	1760.28	1761.07	1761.85	1762.63	1763.42	1764.20	1764.99	1765.78	1766.57	1767.35	21.00
21.10	1767.35											21.10
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A3.2.2. *Type R thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
-0.20	-45.55	-50.17	-54.89									-0.20
-0.10	-3.99	-7.85	-11.76	-15.73	-19.76	-23.86	-28.04	-32.29	-36.62	-41.04	-45.55	-0.10
-0.00	32.00	28.58	25.12	21.63	18.10	14.53	10.92	7.26	3.56	-0.19	-3.99	-0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A3.2.2. Type R thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
0.00	32.00	35.39	38.74	42.06	45.36	48.62	51.85	55.06	58.24	61.40	64.53	0.00
0.10	64.53	67.64	70.73	73.79	76.83	79.85	82.85	85.83	88.79	91.73	94.66	0.10
0.20	94.66	97.56	100.45	103.32	106.18	109.01	111.84	114.65	117.44	120.22	122.98	0.20
0.30	122.98	125.73	128.47	131.19	133.90	136.60	139.28	141.96	144.62	147.27	149.90	0.30
0.40	149.90	152.53	155.14	157.75	160.34	162.93	165.50	168.06	170.61	173.16	175.69	0.40
0.50	175.69	178.22	180.73	183.24	185.74	188.23	190.71	193.18	195.64	198.10	200.54	0.50
0.60	200.54	202.98	205.42	207.84	210.26	212.67	215.07	217.46	219.85	222.23	224.61	0.60
0.70	224.61	226.97	229.33	231.69	234.04	236.38	238.71	241.04	243.36	245.68	247.99	0.70
0.80	247.99	250.30	252.59	254.89	257.18	259.46	261.73	264.00	266.27	268.53	270.79	0.80
0.90	270.79	273.04	275.28	277.52	279.76	281.99	284.21	286.43	288.65	290.86	293.07	0.90
1.00	293.07	295.27	297.47	299.66	301.85	304.03	306.21	308.39	310.56	312.72	314.89	1.00
1.10	314.89	317.05	319.20	321.35	323.50	325.64	327.78	329.92	332.05	334.18	336.30	1.10
1.20	336.30	338.42	340.54	342.65	344.76	346.87	348.97	351.07	353.17	355.26	357.35	1.20
1.30	357.35	359.43	361.52	363.60	365.67	367.74	369.81	371.88	373.94	376.00	378.06	1.30
1.40	378.06	380.12	382.17	384.22	386.26	388.30	390.34	392.38	394.41	396.45	398.47	1.40
1.50	398.47	400.50	402.52	404.54	406.56	408.57	410.59	412.60	414.60	416.61	418.61	1.50
1.60	418.61	420.61	422.61	424.60	426.59	428.58	430.57	432.55	434.53	436.51	438.49	1.60
1.70	438.49	440.47	442.44	444.41	446.38	448.34	450.31	452.27	454.23	456.19	458.14	1.70
1.80	458.14	460.09	462.04	463.99	465.94	467.88	469.83	471.77	473.70	475.64	477.57	1.80
1.90	477.57	479.51	481.44	483.36	485.29	487.22	489.14	491.06	492.98	494.89	496.81	1.90
2.00	496.81	498.72	500.63	502.54	504.45	506.35	508.26	510.16	512.06	513.96	515.85	2.00
2.10	515.85	517.75	519.64	521.53	523.42	525.31	527.20	529.08	530.96	532.85	534.73	2.10
2.20	534.73	536.60	538.48	540.36	542.23	544.10	545.97	547.84	549.71	551.57	553.44	2.20
2.30	553.44	555.30	557.16	559.02	560.88	562.73	564.59	566.44	568.29	570.14	571.99	2.30
2.40	571.99	573.84	575.68	577.53	579.37	581.21	583.06	584.89	586.73	588.57	590.40	2.40
2.50	590.40	592.24	594.07	595.90	597.73	599.56	601.38	603.21	605.03	606.86	608.68	2.50
2.60	608.68	610.50	612.32	614.14	615.95	617.77	619.58	621.40	623.21	625.02	626.83	2.60
2.70	626.83	628.64	630.44	632.25	634.05	635.85	637.66	639.46	641.26	643.06	644.85	2.70
2.80	644.85	646.65	648.44	650.24	652.03	653.82	655.61	657.40	659.19	660.98	662.76	2.80
2.90	662.76	664.55	666.33	668.11	669.90	671.68	673.46	675.23	677.01	678.79	680.56	2.90
3.00	680.56	682.34	684.11	685.88	687.65	689.42	691.19	692.96	694.73	696.49	698.26	3.00
3.10	698.26	700.02	701.78	703.55	705.31	707.07	708.83	710.58	712.34	714.10	715.85	3.10
3.20	715.85	717.60	719.36	721.11	722.86	724.61	726.36	728.11	729.86	731.60	733.35	3.20
3.30	733.35	735.09	736.84	738.58	740.32	742.06	743.80	745.54	747.28	749.02	750.75	3.30
3.40	750.75	752.49	754.22	755.96	757.69	759.42	761.15	762.88	764.61	766.34	768.07	3.40
3.50	768.07	769.79	771.52	773.24	774.97	776.69	778.41	780.14	781.86	783.58	785.30	3.50
3.60	785.30	787.01	788.73	790.45	792.16	793.88	795.59	797.31	799.02	800.73	802.44	3.60
3.70	802.44	804.15	805.86	807.57	809.28	810.98	812.69	814.39	816.10	817.80	819.51	3.70
3.80	819.51	821.21	822.91	824.61	826.31	828.01	829.71	831.40	833.10	834.80	836.49	3.80
3.90	836.49	838.19	839.88	841.57	843.26	844.96	846.65	848.34	850.03	851.71	853.40	3.90
4.00	853.40	855.09	856.77	858.46	860.14	861.83	863.51	865.19	866.88	868.56	870.24	4.00
4.10	870.24	871.92	873.60	875.27	876.95	878.63	880.30	881.98	883.65	885.33	887.00	4.10
4.20	887.00	888.67	890.34	892.01	893.68	895.35	897.02	898.69	900.36	902.03	903.69	4.20
4.30	903.69	905.36	907.02	908.69	910.35	912.01	913.67	915.33	916.99	918.65	920.31	4.30
4.40	920.31	921.97	923.63	925.29	926.94	928.60	930.25	931.91	933.56	935.22	936.87	4.40
4.50	936.87	938.52	940.17	941.82	943.47	945.12	946.77	948.42	950.06	951.71	953.36	4.50
4.60	953.36	955.00	956.65	958.29	959.93	961.57	963.22	964.86	966.50	968.14	969.78	4.60
4.70	969.78	971.42	973.05	974.69	976.33	977.96	979.60	981.23	982.87	984.50	986.14	4.70
4.80	986.14	987.77	989.40	991.03	992.66	994.29	995.92	997.55	999.18	1000.80	1002.43	4.80
4.90	1002.43	1004.06	1005.68	1007.31	1008.93	1010.55	1012.18	1013.80	1015.42	1017.04	1018.66	4.90
5.00	1018.66	1020.28	1021.90	1023.52	1025.14	1026.76	1028.37	1029.99	1031.60	1033.22	1034.83	5.00
5.10	1034.83	1036.45	1038.06	1039.67	1041.29	1042.90	1044.51	1046.12	1047.73	1049.34	1050.94	5.10
5.20	1050.94	1052.55	1054.16	1055.77	1057.37	1058.98	1060.58	1062.19	1063.79	1065.39	1067.00	5.20
5.30	1067.00	1068.60	1070.20	1071.80	1073.40	1075.00	1076.60	1078.20	1079.80	1081.39	1082.99	5.30
5.40	1082.99	1084.59	1086.18	1087.78	1089.37	1090.97	1092.56	1094.15	1095.75	1097.34	1098.93	5.40
5.50	1098.93	1100.52	1102.11	1103.70	1105.29	1106.88	1108.47	1110.05	1111.64	1113.23	1114.81	5.50
5.60	1114.81	1116.40	1117.98	1119.57	1121.15	1122.73	1124.32	1125.90	1127.48	1129.06	1130.64	5.60
5.70	1130.64	1132.22	1133.80	1135.38	1136.96	1138.54	1140.11	1141.69	1143.27	1144.84	1146.42	5.70
5.80	1146.42	1147.99	1149.57	1151.14	1152.71	1154.29	1155.86	1157.43	1159.00	1160.57	1162.14	5.80
5.90	1162.14	1163.71	1165.28	1166.85	1168.42	1169.98	1171.55	1173.11	1174.67	1176.23	1177.80	5.90
6.00	1177.80	1179.36	1180.92	1182.48	1184.04	1185.60	1187.16	1188.71	1190.27	1191.83	1193.38	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A3.2.2. Type R thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
6.00	1177.80	1179.36	1180.92	1182.48	1184.04	1185.60	1187.16	1188.71	1190.27	1191.83	1193.38	6.00
6.10	1193.38	1194.94	1196.50	1198.05	1199.60	1201.16	1202.71	1204.26	1205.81	1207.37	1208.92	6.10
6.20	1208.92	1210.47	1212.02	1213.56	1215.11	1216.66	1218.21	1219.75	1221.30	1222.85	1224.39	6.20
6.30	1224.39	1225.93	1227.48	1229.02	1230.56	1232.11	1233.65	1235.19	1236.73	1238.27	1239.81	6.30
6.40	1239.81	1241.35	1242.89	1244.42	1245.96	1247.50	1249.03	1250.57	1252.10	1253.64	1255.17	6.40
6.50	1255.17	1256.70	1258.24	1259.77	1261.30	1262.83	1264.36	1265.89	1267.42	1268.95	1270.48	6.50
6.60	1270.48	1272.01	1273.54	1275.06	1276.59	1278.11	1279.64	1281.16	1282.69	1284.21	1285.74	6.60
6.70	1285.74	1287.26	1288.78	1290.30	1291.82	1293.34	1294.86	1296.38	1297.90	1299.42	1300.94	6.70
6.80	1300.94	1302.46	1303.97	1305.49	1307.00	1308.52	1310.03	1311.55	1313.06	1314.58	1316.09	6.80
6.90	1316.09	1317.60	1319.11	1320.62	1322.13	1323.64	1325.15	1326.66	1328.17	1329.68	1331.19	6.90
7.00	1331.19	1332.69	1334.20	1335.71	1337.21	1338.72	1340.22	1341.73	1343.23	1344.73	1346.23	7.00
7.10	1346.23	1347.74	1349.24	1350.74	1352.24	1353.74	1355.24	1356.74	1358.24	1359.73	1361.23	7.10
7.20	1361.23	1362.73	1364.23	1365.72	1367.22	1368.71	1370.21	1371.70	1373.19	1374.69	1376.18	7.20
7.30	1376.18	1377.67	1379.16	1380.65	1382.14	1383.63	1385.12	1386.61	1388.10	1389.59	1391.08	7.30
7.40	1391.08	1392.57	1394.05	1395.54	1397.02	1398.51	1399.99	1401.48	1402.96	1404.45	1405.93	7.40
7.50	1405.93	1407.41	1408.89	1410.37	1411.86	1413.34	1414.82	1416.30	1417.77	1419.25	1420.73	7.50
7.60	1420.73	1422.21	1423.69	1425.16	1426.64	1428.11	1429.59	1431.07	1432.54	1434.01	1435.49	7.60
7.70	1435.49	1436.96	1438.43	1439.90	1441.38	1442.85	1444.32	1445.79	1447.26	1448.73	1450.20	7.70
7.80	1450.20	1451.66	1453.13	1454.60	1456.07	1457.53	1459.00	1460.46	1461.93	1463.39	1464.86	7.80
7.90	1464.86	1466.32	1467.79	1469.25	1470.71	1472.17	1473.63	1475.10	1476.56	1478.02	1479.48	7.90
8.00	1479.48	1480.94	1482.39	1483.85	1485.31	1486.77	1488.23	1489.68	1491.14	1492.59	1494.05	8.00
8.10	1494.05	1495.50	1496.96	1498.41	1499.87	1501.32	1502.77	1504.22	1505.67	1507.13	1508.58	8.10
8.20	1508.58	1510.03	1511.48	1512.93	1514.38	1515.82	1517.27	1518.72	1520.17	1521.61	1523.06	8.20
8.30	1523.06	1524.51	1525.95	1527.40	1528.84	1530.29	1531.73	1533.17	1534.62	1536.06	1537.50	8.30
8.40	1537.50	1538.94	1540.39	1541.83	1543.27	1544.71	1546.15	1547.59	1549.02	1550.46	1551.90	8.40
8.50	1551.90	1553.34	1554.77	1556.21	1557.65	1559.08	1560.52	1561.95	1563.39	1564.82	1566.26	8.50
8.60	1566.26	1567.69	1569.12	1570.55	1571.99	1573.42	1574.85	1576.28	1577.71	1579.14	1580.57	8.60
8.70	1580.57	1582.00	1583.43	1584.86	1586.28	1587.71	1589.14	1590.56	1591.99	1593.42	1594.84	8.70
8.80	1594.84	1596.27	1597.69	1599.12	1600.54	1601.96	1603.39	1604.81	1606.23	1607.65	1609.07	8.80
8.90	1609.07	1610.49	1611.92	1613.34	1614.76	1616.17	1617.59	1619.01	1620.43	1621.85	1623.27	8.90
9.00	1623.27	1624.68	1626.10	1627.51	1628.93	1630.35	1631.76	1633.18	1634.59	1636.00	1637.42	9.00
9.10	1637.42	1638.83	1640.24	1641.65	1643.07	1644.48	1645.89	1647.30	1648.71	1650.12	1651.53	9.10
9.20	1651.53	1652.94	1654.35	1655.75	1657.16	1658.57	1659.98	1661.38	1662.79	1664.19	1665.60	9.20
9.30	1665.60	1667.01	1668.41	1669.81	1671.22	1672.62	1674.03	1675.43	1676.83	1678.23	1679.63	9.30
9.40	1679.63	1681.04	1682.44	1683.84	1685.24	1686.64	1688.04	1689.44	1690.83	1692.23	1693.63	9.40
9.50	1693.63	1695.03	1696.42	1697.82	1699.22	1700.61	1702.01	1703.40	1704.80	1706.19	1707.59	9.50
9.60	1707.59	1708.98	1710.37	1711.77	1713.16	1714.55	1715.94	1717.34	1718.73	1720.12	1721.51	9.60
9.70	1721.51	1722.90	1724.29	1725.68	1727.07	1728.45	1729.84	1731.23	1732.62	1734.00	1735.39	9.70
9.80	1735.39	1736.78	1738.16	1739.55	1740.93	1742.32	1743.70	1745.09	1746.47	1747.85	1749.24	9.80
9.90	1749.24	1750.62	1752.00	1753.38	1754.77	1756.15	1757.53	1758.91	1760.29	1761.67	1763.05	9.90
10.00	1763.05	1764.43	1765.81	1767.18	1768.56	1769.94	1771.32	1772.69	1774.07	1775.45	1776.82	10.00
10.10	1776.82	1778.20	1779.57	1780.95	1782.32	1783.70	1785.07	1786.44	1787.82	1789.19	1790.56	10.10
10.20	1790.56	1791.93	1793.31	1794.68	1796.05	1797.42	1798.79	1800.16	1801.53	1802.90	1804.27	10.20
10.30	1804.27	1805.63	1807.00	1808.37	1809.74	1811.10	1812.47	1813.84	1815.20	1816.57	1817.94	10.30
10.40	1817.94	1819.30	1820.66	1822.03	1823.39	1824.76	1826.12	1827.48	1828.85	1830.21	1831.57	10.40
10.50	1831.57	1832.93	1834.29	1835.65	1837.01	1838.37	1839.73	1841.09	1842.45	1843.81	1845.17	10.50
10.60	1845.17	1846.53	1847.89	1849.24	1850.60	1851.96	1853.32	1854.67	1856.03	1857.38	1858.74	10.60
10.70	1858.74	1860.09	1861.45	1862.80	1864.16	1865.51	1866.86	1868.22	1869.57	1870.92	1872.27	10.70
10.80	1872.27	1873.62	1874.97	1876.33	1877.68	1879.03	1880.38	1881.73	1883.08	1884.42	1885.77	10.80
10.90	1885.77	1887.12	1888.47	1889.82	1891.16	1892.51	1893.86	1895.20	1896.55	1897.90	1899.24	10.90
11.00	1899.24	1900.59	1901.93	1903.27	1904.62	1905.96	1907.31	1908.65	1909.99	1911.33	1912.68	11.00
11.10	1912.68	1914.02	1915.36	1916.70	1918.04	1919.38	1920.72	1922.06	1923.40	1924.74	1926.08	11.10
11.20	1926.08	1927.42	1928.76	1930.10	1931.43	1932.77	1934.11	1935.44	1936.78	1938.12	1939.45	11.20
11.30	1939.45	1940.79	1942.12	1943.46	1944.79	1946.13	1947.46	1948.79	1950.13	1951.46	1952.79	11.30
11.40	1952.79	1954.13	1955.46	1956.79	1958.12	1959.45	1960.78	1962.11	1963.45	1964.78	1966.11	11.40
11.50	1966.11	1967.44	1968.77	1970.09	1971.42	1972.75	1974.08	1975.41	1976.74	1978.06	1979.39	11.50
11.60	1979.39	1980.72	1982.05	1983.37	1984.70	1986.02	1987.35	1988.68	1990.00	1991.33	1992.65	11.60
11.70	1992.65	1993.98	1995.30	1996.62	1997.95	1999.27	2000.59	2001.92	2003.24	2004.56	2005.89	11.70
11.80	2005.89	2007.21	2008.53	2009.85	2011.17	2012.49	2013.81	2015.14	2016.46	2017.78	2019.10	11.80
11.90	2019.10	2020.42	2021.73	2023.05	2024.37	2025.69	2027.01	2028.33	2029.65	2030.96	2032.28	11.90
12.00	2032.28	2033.60	2034.92	2036.23	2037.55	2038.87	2040.18	2041.50	2042.81	2044.13	2045.44	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A3.2. Type R thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
12.00	2032.28	2033.60	2034.92	2036.23	2037.55	2038.87	2040.18	2041.50	2042.81	2044.13	2045.44	12.00
12.10	2045.44	2046.76	2048.07	2049.39	2050.70	2052.02	2053.33	2054.65	2055.96	2057.27	2058.58	12.10
12.20	2058.58	2059.90	2061.21	2062.52	2063.84	2065.15	2066.46	2067.77	2069.08	2070.39	2071.70	12.20
12.30	2071.70	2073.01	2074.33	2075.64	2076.95	2078.26	2079.57	2080.87	2082.18	2083.49	2084.80	12.30
12.40	2084.80	2086.11	2087.42	2088.73	2090.04	2091.36	2092.65	2093.96	2095.27	2096.57	2097.88	12.40
12.50	2097.88	2099.19	2100.49	2101.80	2103.10	2104.41	2105.72	2107.02	2108.33	2109.63	2110.94	12.50
12.60	2110.94	2112.24	2113.55	2114.85	2116.16	2117.46	2118.76	2120.07	2121.37	2122.67	2123.98	12.60
12.70	2123.98	2125.28	2126.58	2127.88	2129.19	2130.49	2131.79	2133.09	2134.39	2135.70	2137.00	12.70
12.80	2137.00	2138.30	2139.60	2140.90	2142.20	2143.50	2144.80	2146.10	2147.40	2148.70	2150.00	12.80
12.90	2150.00	2151.30	2152.60	2153.90	2155.20	2156.50	2157.79	2159.09	2160.39	2161.69	2162.99	12.90
13.00	2162.99	2164.28	2165.58	2166.88	2168.18	2169.47	2170.77	2172.07	2173.36	2174.66	2175.96	13.00
13.10	2175.96	2177.25	2178.55	2179.84	2181.14	2182.44	2183.73	2185.03	2186.32	2187.62	2188.91	13.10
13.20	2188.91	2190.20	2191.50	2192.79	2194.09	2195.38	2196.68	2197.97	2199.26	2200.56	2201.85	13.20
13.30	2201.85	2203.14	2204.44	2205.73	2207.02	2208.31	2209.61	2210.90	2212.19	2213.48	2214.77	13.30
13.40	2214.77	2216.07	2217.36	2218.65	2219.94	2221.23	2222.52	2223.81	2225.10	2226.39	2227.68	13.40
13.50	2227.68	2228.97	2230.26	2231.55	2232.84	2234.13	2235.42	2236.71	2238.00	2239.29	2240.58	13.50
13.60	2240.58	2241.87	2243.16	2244.45	2245.74	2247.02	2248.31	2249.60	2250.89	2252.18	2253.47	13.60
13.70	2253.47	2254.75	2256.04	2257.33	2258.62	2259.90	2261.19	2262.48	2263.76	2265.05	2266.34	13.70
13.80	2266.34	2267.62	2268.91	2270.20	2271.48	2272.77	2274.06	2275.34	2276.63	2277.91	2279.20	13.80
13.90	2279.20	2280.48	2281.77	2283.05	2284.34	2285.62	2286.91	2288.19	2289.48	2290.76	2292.05	13.90
14.00	2292.05	2293.33	2294.62	2295.90	2297.18	2298.47	2299.75	2301.04	2302.32	2303.60	2304.89	14.00
14.10	2304.89	2306.17	2307.45	2308.74	2310.02	2311.30	2312.59	2313.87	2315.15	2316.43	2317.72	14.10
14.20	2317.72	2319.00	2320.28	2321.56	2322.84	2324.13	2325.41	2326.69	2327.97	2329.25	2330.54	14.20
14.30	2330.54	2331.82	2333.10	2334.38	2335.66	2336.94	2338.22	2339.50	2340.79	2342.07	2343.35	14.30
14.40	2343.35	2344.63	2345.91	2347.19	2348.47	2349.75	2351.03	2352.31	2353.59	2354.87	2356.15	14.40
14.50	2356.15	2357.43	2358.71	2359.99	2361.27	2362.55	2363.83	2365.11	2366.39	2367.67	2368.95	14.50
14.60	2368.95	2370.22	2371.50	2372.78	2374.06	2375.34	2376.62	2377.90	2379.18	2380.45	2381.73	14.60
14.70	2381.73	2383.01	2384.29	2385.57	2386.85	2388.12	2389.40	2390.68	2391.96	2393.24	2394.51	14.70
14.80	2394.51	2395.79	2397.07	2398.35	2399.63	2400.90	2402.18	2403.46	2404.74	2406.01	2407.29	14.80
14.90	2407.29	2408.57	2409.85	2411.12	2412.40	2413.68	2414.95	2416.23	2417.51	2418.78	2420.06	14.90
15.00	2420.06	2421.34	2422.61	2423.89	2425.17	2426.44	2427.72	2429.00	2430.27	2431.55	2432.83	15.00
15.10	2432.83	2434.10	2435.38	2436.65	2437.93	2439.21	2440.48	2441.76	2443.03	2444.31	2445.59	15.10
15.20	2445.59	2446.86	2448.14	2449.41	2450.69	2451.97	2453.24	2454.52	2455.79	2457.07	2458.34	15.20
15.30	2458.34	2459.62	2460.89	2462.17	2463.45	2464.72	2466.00	2467.27	2468.55	2469.82	2471.10	15.30
15.40	2471.10	2472.37	2473.65	2474.92	2476.20	2477.47	2478.75	2480.02	2481.30	2482.57	2483.85	15.40
15.50	2483.85	2485.12	2486.40	2487.67	2488.95	2490.22	2491.50	2492.77	2494.05	2495.32	2496.60	15.50
15.60	2496.60	2497.87	2499.15	2500.42	2501.69	2502.97	2504.24	2505.52	2506.79	2508.07	2509.34	15.60
15.70	2509.34	2510.62	2511.89	2513.17	2514.44	2515.72	2516.99	2518.26	2519.54	2520.81	2522.09	15.70
15.80	2522.09	2523.36	2524.64	2525.91	2527.19	2528.46	2529.73	2531.01	2532.28	2533.56	2534.83	15.80
15.90	2534.83	2536.11	2537.38	2538.66	2539.93	2541.20	2542.48	2543.75	2545.03	2546.30	2547.58	15.90
16.00	2547.58	2548.85	2550.13	2551.40	2552.67	2553.95	2555.22	2556.50	2557.77	2559.05	2560.32	16.00
16.10	2560.32	2561.60	2562.87	2564.15	2565.42	2566.69	2567.97	2569.24	2570.52	2571.79	2573.07	16.10
16.20	2573.07	2574.34	2575.62	2576.89	2578.17	2579.44	2580.72	2581.99	2583.26	2584.54	2585.81	16.20
16.30	2585.81	2587.09	2588.36	2589.64	2590.91	2592.19	2593.46	2594.74	2596.01	2597.29	2598.56	16.30
16.40	2598.56	2599.84	2601.11	2602.39	2603.66	2604.94	2606.21	2607.49	2608.76	2610.04	2611.31	16.40
16.50	2611.31	2612.59	2613.87	2615.14	2616.42	2617.69	2618.97	2620.24	2621.52	2622.79	2624.07	16.50
16.60	2624.07	2625.34	2626.62	2627.90	2629.17	2630.45	2631.72	2633.00	2634.27	2635.55	2636.83	16.60
16.70	2636.83	2638.10	2639.38	2640.65	2641.93	2643.21	2644.48	2645.76	2647.04	2648.31	2649.59	16.70
16.80	2649.59	2650.86	2652.14	2653.42	2654.69	2655.97	2657.25	2658.52	2659.80	2661.08	2662.35	16.80
16.90	2662.35	2663.63	2664.91	2666.19	2667.46	2668.74	2670.02	2671.29	2672.57	2673.85	2675.13	16.90
17.00	2675.13	2676.40	2677.68	2678.96	2680.24	2681.51	2682.79	2684.07	2685.35	2686.63	2687.90	17.00
17.10	2687.90	2689.18	2690.46	2691.74	2693.02	2694.29	2695.57	2696.85	2698.13	2699.41	2700.69	17.10
17.20	2700.69	2701.96	2703.24	2704.52	2705.80	2707.08	2708.36	2709.64	2710.92	2712.20	2713.48	17.20
17.30	2713.48	2714.76	2716.03	2717.31	2718.59	2719.87	2721.15	2722.43	2723.71	2724.99	2726.27	17.30
17.40	2726.27	2727.55	2728.83	2730.11	2731.39	2732.67	2733.96	2735.24	2736.52	2737.80	2739.08	17.40
17.50	2739.08	2740.36	2741.64	2742.92	2744.20	2745.48	2746.77	2748.05	2749.33	2750.61	2751.89	17.50
17.60	2751.89	2753.17	2754.46	2755.74	2757.02	2758.30	2759.58	2760.87	2762.15	2763.43	2764.71	17.60
17.70	2764.71	2766.00	2767.28	2768.56	2769.84	2771.13	2772.41	2773.69	2774.98	2776.26	2777.55	17.70
17.80	2777.55	2778.83	2780.11	2781.40	2782.68	2783.96	2785.25	2786.53	2787.82	2789.10	2790.39	17.80
17.90	2790.39	2791.67	2792.96	2794.24	2795.53	2796.81	2798.10	2799.38	2800.67	2801.95	2803.24	17.90
18.00	2803.24	2804.52	2805.81	2807.10	2808.38	2809.67	2810.96	2812.24	2813.53	2814.82	2816.10	18.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A3.2.2. Type R thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
18.00	2803.24	2804.52	2805.81	2807.10	2808.38	2809.67	2810.96	2812.24	2813.53	2814.82	2816.10	18.00
18.10	2816.10	2817.39	2818.68	2819.96	2821.25	2822.54	2823.83	2825.11	2826.40	2827.69	2828.98	18.10
18.20	2828.98	2830.27	2831.55	2832.84	2834.13	2835.42	2836.71	2838.00	2839.29	2840.58	2841.86	18.20
18.30	2841.86	2843.15	2844.44	2845.73	2847.02	2848.31	2849.60	2850.89	2852.18	2853.47	2854.76	18.30
18.40	2854.76	2856.06	2857.35	2858.64	2859.93	2861.22	2862.51	2863.80	2865.09	2866.39	2867.68	18.40
18.50	2867.68	2868.97	2870.26	2871.56	2872.85	2874.14	2875.43	2876.73	2878.02	2879.31	2880.61	18.50
18.60	2880.61	2881.90	2883.19	2884.49	2885.78	2887.08	2888.37	2889.66	2890.96	2892.25	2893.55	18.60
18.70	2893.55	2894.84	2896.14	2897.43	2898.73	2900.03	2901.32	2902.62	2903.91	2905.21	2906.51	18.70
18.80	2906.51	2907.80	2909.10	2910.40	2911.69	2912.99	2914.29	2915.59	2916.88	2918.18	2919.48	18.80
18.90	2919.48	2920.78	2922.08	2923.38	2924.67	2925.97	2927.27	2928.57	2929.87	2931.17	2932.47	18.90
19.00	2932.47	2933.77	2935.07	2936.37	2937.67	2938.97	2940.27	2941.57	2942.87	2944.18	2945.48	19.00
19.10	2945.48	2946.78	2948.08	2949.38	2950.69	2951.99	2953.29	2954.59	2955.90	2957.20	2958.50	19.10
19.20	2958.50	2959.81	2961.11	2962.41	2963.72	2965.02	2966.33	2967.63	2968.94	2970.24	2971.55	19.20
19.30	2971.55	2972.85	2974.16	2975.46	2976.77	2978.08	2979.38	2980.69	2982.00	2983.30	2984.61	19.30
19.40	2984.61	2985.92	2987.22	2988.53	2989.84	2991.15	2992.46	2993.77	2995.07	2996.38	2997.69	19.40
19.50	2997.69	2999.00	3000.31	3001.62	3002.93	3004.24	3005.55	3006.86	3008.17	3009.48	3010.79	19.50
19.60	3010.79	3012.11	3013.42	3014.73	3016.04	3017.35	3018.67	3019.98	3021.29	3022.61	3023.92	19.60
19.70	3023.92	3025.23	3026.55	3027.86	3029.17	3030.49	3031.80	3033.12	3034.43	3035.75	3037.07	19.70
19.80	3037.07	3038.38	3039.70	3041.01	3042.33	3043.65	3044.97	3046.28	3047.60	3048.92	3050.24	19.80
19.90	3050.24	3051.56	3052.88	3054.20	3055.52	3056.84	3058.16	3059.48	3060.80	3062.12	3063.44	19.90
20.00	3063.44	3064.77	3066.09	3067.41	3068.74	3070.06	3071.39	3072.71	3074.04	3075.36	3076.69	20.00
20.10	3076.69	3078.02	3079.35	3080.67	3082.00	3083.33	3084.66	3085.99	3087.32	3088.65	3089.99	20.10
20.20	3089.99	3091.32	3092.65	3093.99	3095.32	3096.65	3097.99	3099.33	3100.66	3102.00	3103.34	20.20
20.30	3103.34	3104.68	3106.02	3107.36	3108.70	3110.04	3111.38	3112.72	3114.06	3115.41	3116.75	20.30
20.40	3116.75	3118.10	3119.44	3120.79	3122.14	3123.49	3124.84	3126.19	3127.54	3128.89	3130.24	20.40
20.50	3130.24	3131.59	3132.95	3134.30	3135.66	3137.02	3138.37	3139.73	3141.09	3142.45	3143.81	20.50
20.60	3143.81	3145.17	3146.54	3147.90	3149.26	3150.63	3152.00	3153.36	3154.73	3156.10	3157.47	20.60
20.70	3157.47	3158.84	3160.22	3161.59	3162.96	3164.34	3165.72	3167.09	3168.47	3169.85	3171.23	20.70
20.80	3171.23	3172.62	3174.00	3175.38	3176.77	3178.16	3179.54	3180.93	3182.32	3183.72	3185.11	20.80
20.90	3185.11	3186.50	3187.90	3189.29	3190.69	3192.09	3193.49	3194.89	3196.30	3197.70	3199.11	20.90
21.00	3199.11	3200.51	3201.92	3203.33	3204.74	3206.15	3207.57	3208.98	3210.40	3211.82	3213.24	21.00
21.10	3213.24											21.10
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A3.2.3. Type R thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges (°C). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius

Temperature Range (°C)	a_0		a_1		a_2		a_3		a_4		Error Range (°C)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
- 50 to 900	.....	..	1.6251434	-1	-2.0454379	-5	2.5404935	-9	-1.1767904	-13	-13 to 3
0 to 1100	.....	..	1.5239494	-1	-1.3755675	-5	1.2610922	-9	-4.4281251	-14	- 4 to 7
0 to 1400	.....	..	1.4441607	-1	-9.5014952	-6	6.2073358	-10	-1.5622497	-14	- 6 to 10
0 to 1650	.....	..	1.3944190	-1	-7.4485484	-6	3.8266182	-10	-7.4517277	-15	- 7 to 13
0 to 1768	.....	..	1.3752883	-1	-6.7651171	-6	3.1420473	-10	-5.4254872	-15	- 7 to 14
400 to 1100	4.5509556	+1	1.1284875	-1	-2.8603978	-6	8.5173702	-11	-1.1440038	-15	-.04 to .04
400 to 1400	4.9160016	+1	1.1054589	-1	-2.3559046	-6	3.9276248	-11	3.3369324	-16	-.08 to .09
400 to 1650	4.8343651	+1	1.1098270	-1	-2.4353890	-6	4.5164488	-11	1.8172612	-16	-.10 to .12
1050 to 1400	-4.1134459	+0	1.2738464	-1	-4.3132296	-6	1.3863582	-10	-1.5283798	-15	-.002 to .002
1050 to 1650	3.7487318	+1	1.1519304	-1	-2.9827002	-6	7.4538667	-11	-3.7809957	-16	-.011 to .011
1400 to 1550	8.0559850	+1	1.0442877	-1	-1.9827500	-6	3.3603790	-11	2.4513433	-16	-.0005 to .0005
1400 to 1650	1.4180146	+2	9.0181346	-2	-7.4068329	-7	-1.4487255	-11	9.4290495	-16	-.0005 to .0005
1400 to 1768	3.1759093	+3	-5.8922431	-1	5.6190639	-5	-2.1303241	-9	3.0369250	-14	-.11 to .08
1666 to 1768	1.2883437	+4	-2.6747958	+0	2.2334214	-4	-8.0565860	-9	1.0882779	-13	-.0007 to .0007
II. Cubic Equation											
- 50 to 900	.....	..	1.4639267	-1	-9.6516598	-6	4.7870066	-10	.....	..	-17 to 10
0 to 1100	.....	..	1.3925975	-1	-6.9755824	-6	2.6013753	-10	.....	..	-7 to 13
0 to 1400	.....	..	1.3291312	-1	-5.1159870	-6	1.4261258	-10	.....	..	-8 to 17
0 to 1650	.....	..	1.2943791	-1	-4.3282878	-6	1.0429596	-10	.....	..	-8 to 20
0 to 1768	.....	..	1.2827231	-1	-4.1012169	-6	9.4846033	-11	.....	..	-8 to 21
400 to 1100	4.8206741	+1	1.1114775	-1	-2.4842910	-6	5.0387148	-11	.....	..	-.07 to .07
400 to 1400	4.7397025	+1	1.1150030	-1	-2.5301296	-6	5.2198550	-11	.....	..	-.15 to .10
400 to 1650	4.6674533	+1	1.1179913	-1	-2.5659255	-6	5.3473173	-11	.....	..	-.12 to .20
1050 to 1400	4.6486248	+1	1.1225711	-1	-2.6264781	-6	5.5498996	-11	.....	..	-.008 to .008
1050 to 1650	5.6939888	+1	1.0992545	-1	-2.4547544	-6	5.1322232	-11	.....	..	-.022 to .020
1400 to 1550	5.9754422	+1	1.0930924	-1	-2.4117917	-6	5.0356145	-11	.....	..	-.0005 to .0005
1400 to 1650	4.8577986	+1	1.1126194	-1	-2.5253803	-6	5.2555985	-11	.....	..	-.002 to .002
1400 to 1768	-3.6801831	+2	1.8138449	-1	6.4482742	-6	1.2549458	-10	.....	..	-.30 to .15
1666 to 1768	-6.0385387	+3	1.0327854	+0	-4.9031858	-5	8.3496401	-10	.....	..	-.004 to .004
III. Quadratic Equation											
- 50 to 900	.....	..	1.2930490	-1	-3.5743959	-6	.....	..	.....	..	-21 to 19
0 to 1100	.....	..	1.2394223	-1	-2.7354208	-6	.....	..	.....	..	-13 to 25
0 to 1400	.....	..	1.1756389	-1	-1.9720760	-6	.....	..	.....	..	-18 to 32
0 to 1650	.....	..	1.1279400	-1	-1.5298755	-6	.....	..	.....	..	-24 to 39
0 to 1768	.....	..	1.1059188	-1	-1.3521642	-6	.....	..	.....	..	-28 to 43
400 to 1100	6.5734458	+1	1.0299926	-1	-1.3322502	-6	.....	..	.....	..	-1.3 to 1.1
400 to 1400	8.1035455	+1	9.8212995	-2	-1.0100842	-6	.....	..	.....	..	-4 to 4
400 to 1650	9.9131606	+1	9.3227227	-2	-7.2969415	-7	.....	..	.....	..	-9 to 9
1050 to 1400	1.8304368	+2	8.1681459	-2	-3.6178430	-7	.....	..	.....	..	-.26 to .24
1050 to 1650	2.3296446	+2	7.4274394	-2	-9.1467292	-8	.....	..	.....	..	-1.2 to 1.2
1400 to 1550	3.1055825	+2	6.5211548	-2	1.7039953	-7	.....	..	.....	..	-.019 to .018
1400 to 1650	3.4238682	+2	6.1485536	-2	2.7924100	-7	.....	..	.....	..	-.09 to .09
1400 to 1768	4.2575948	+2	5.2056334	-2	5.4466917	-7	.....	..	.....	..	-.7 to .8
1666 to 1768	1.0787621	+3	-1.2735666	-2	2.1501038	-6	.....	..	.....	..	-.08 to .08

A4. Supplementary Data for Type B—*Platinum*–30% Rhodium Alloy Versus *Platinum*–6% Rhodium Alloy Thermocouples

A4.1. Data for Voltage as a Function of Temperature

The full precision coefficients given in the main text are used to generate the voltage as a function of temperature data given in tables A4.1.1 and A4.1.2. Table A4.1.1 presents the data in degrees Celsius from 0 °C to 1820 °C while table A4.1.2 presents the data in degrees Fahrenheit from 32 °F to 3308 °F. Table A4.1.3 contains quadratic, cubic, and quartic approximations to the data as a function of temperature in selected temperature ranges. The error range given in the table is the difference between the voltage as obtained from the full precision coefficients from the text and the respective reduced order approximations. The last entries in the cubic and quadratic groupings of table A4.1.3 represent variable reference junction corrections in the 0 to 50 °C temperature range. In the narrower temperature range near room temperatures, 20 to 25 °C, the error range for the given *quadratic* equation is smaller than that listed in the last column: $\pm 0.04 \mu\text{V}$.

TABLE A4.1.1. Type B thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	0.000	-0.000	-0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.002	-0.002	0
10	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.003	-0.003	-0.003	10
20	-0.003	-0.003	-0.003	-0.003	-0.003	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	20
30	-0.002	-0.002	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.000	30
40	-0.000	-0.000	-0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.002	0.002	40
50	0.002	0.003	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.006	0.006	50
60	0.006	0.007	0.007	0.008	0.008	0.009	0.009	0.010	0.010	0.011	0.011	60
70	0.011	0.012	0.012	0.013	0.014	0.014	0.015	0.015	0.016	0.017	0.017	70
80	0.017	0.018	0.019	0.020	0.020	0.021	0.022	0.022	0.023	0.024	0.025	80
90	0.025	0.026	0.026	0.027	0.028	0.029	0.030	0.031	0.031	0.032	0.033	90
100	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	100
110	0.043	0.044	0.045	0.046	0.047	0.048	0.049	0.050	0.051	0.052	0.053	110
120	0.053	0.055	0.056	0.057	0.058	0.059	0.060	0.062	0.063	0.064	0.065	120
130	0.065	0.066	0.068	0.069	0.070	0.071	0.073	0.074	0.075	0.077	0.078	130
140	0.078	0.079	0.081	0.082	0.083	0.085	0.086	0.088	0.089	0.091	0.092	140
150	0.092	0.093	0.095	0.096	0.098	0.099	0.101	0.102	0.104	0.106	0.107	150
160	0.107	0.109	0.110	0.112	0.113	0.115	0.117	0.118	0.120	0.122	0.123	160
170	0.123	0.125	0.127	0.128	0.130	0.132	0.133	0.135	0.137	0.139	0.140	170
180	0.140	0.142	0.144	0.146	0.148	0.149	0.151	0.153	0.155	0.157	0.159	180
190	0.159	0.161	0.163	0.164	0.166	0.168	0.170	0.172	0.174	0.176	0.178	190
200	0.178	0.180	0.182	0.184	0.186	0.188	0.190	0.192	0.194	0.197	0.199	200
210	0.199	0.201	0.203	0.205	0.207	0.209	0.211	0.214	0.216	0.218	0.220	210
220	0.220	0.222	0.225	0.227	0.229	0.231	0.234	0.236	0.238	0.240	0.243	220
230	0.243	0.245	0.247	0.250	0.252	0.254	0.257	0.259	0.262	0.264	0.266	230
240	0.266	0.269	0.271	0.274	0.276	0.279	0.281	0.284	0.286	0.289	0.291	240
250	0.291	0.294	0.296	0.299	0.301	0.304	0.307	0.309	0.312	0.314	0.317	250
260	0.317	0.320	0.322	0.325	0.328	0.330	0.333	0.336	0.338	0.341	0.344	260
270	0.344	0.347	0.349	0.352	0.355	0.358	0.360	0.363	0.366	0.369	0.372	270
280	0.372	0.375	0.377	0.380	0.383	0.386	0.389	0.392	0.395	0.398	0.401	280
290	0.401	0.404	0.406	0.409	0.412	0.415	0.418	0.421	0.424	0.427	0.431	290
300	0.431	0.434	0.437	0.440	0.443	0.446	0.449	0.452	0.455	0.458	0.462	300
310	0.462	0.465	0.468	0.471	0.474	0.477	0.481	0.484	0.487	0.490	0.494	310
320	0.494	0.497	0.500	0.503	0.507	0.510	0.513	0.517	0.520	0.523	0.527	320
330	0.527	0.530	0.533	0.537	0.540	0.544	0.547	0.550	0.554	0.557	0.561	330
340	0.561	0.564	0.568	0.571	0.575	0.578	0.582	0.585	0.589	0.592	0.596	340
350	0.596	0.599	0.603	0.606	0.610	0.614	0.617	0.621	0.625	0.628	0.632	350
360	0.632	0.636	0.639	0.643	0.647	0.650	0.654	0.658	0.661	0.665	0.669	360
370	0.669	0.673	0.677	0.680	0.684	0.688	0.692	0.696	0.699	0.703	0.707	370
380	0.707	0.711	0.715	0.719	0.723	0.727	0.730	0.734	0.738	0.742	0.746	380
390	0.746	0.750	0.754	0.758	0.762	0.766	0.770	0.774	0.778	0.782	0.786	390
400	0.786	0.790	0.794	0.799	0.803	0.807	0.811	0.815	0.819	0.823	0.827	400
410	0.827	0.832	0.836	0.840	0.844	0.848	0.853	0.857	0.861	0.865	0.870	410
420	0.870	0.874	0.878	0.882	0.887	0.891	0.895	0.900	0.904	0.908	0.913	420
430	0.913	0.917	0.921	0.926	0.930	0.935	0.939	0.943	0.948	0.952	0.957	430
440	0.957	0.961	0.966	0.970	0.975	0.979	0.984	0.988	0.993	0.997	1.002	440
450	1.002	1.006	1.011	1.015	1.020	1.025	1.029	1.034	1.039	1.043	1.048	450
460	1.048	1.052	1.057	1.062	1.066	1.071	1.076	1.081	1.085	1.090	1.095	460
470	1.095	1.100	1.104	1.109	1.114	1.119	1.123	1.128	1.133	1.138	1.143	470
480	1.143	1.148	1.152	1.157	1.162	1.167	1.172	1.177	1.182	1.187	1.192	480
490	1.192	1.197	1.202	1.206	1.211	1.216	1.221	1.226	1.231	1.236	1.241	490
500	1.241	1.246	1.252	1.257	1.262	1.267	1.272	1.277	1.282	1.287	1.292	500
510	1.292	1.297	1.303	1.308	1.313	1.318	1.323	1.328	1.334	1.339	1.344	510
520	1.344	1.349	1.354	1.360	1.365	1.370	1.375	1.381	1.386	1.391	1.397	520
530	1.397	1.402	1.407	1.413	1.418	1.423	1.429	1.434	1.439	1.445	1.450	530
540	1.450	1.456	1.461	1.467	1.472	1.477	1.483	1.488	1.494	1.499	1.505	540
550	1.505	1.510	1.516	1.521	1.527	1.532	1.538	1.544	1.549	1.555	1.560	550
560	1.560	1.566	1.571	1.577	1.583	1.588	1.594	1.600	1.605	1.611	1.617	560
570	1.617	1.622	1.628	1.634	1.639	1.645	1.651	1.657	1.662	1.668	1.674	570
580	1.674	1.680	1.685	1.691	1.697	1.703	1.709	1.715	1.720	1.726	1.732	580
590	1.732	1.738	1.744	1.750	1.756	1.762	1.767	1.773	1.779	1.785	1.791	590
600	1.791	1.797	1.803	1.809	1.815	1.821	1.827	1.833	1.839	1.845	1.851	600
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A4.1.1. Type B thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C —Continued

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	1.791	1.797	1.803	1.809	1.815	1.821	1.827	1.833	1.839	1.845	1.851	600
610	1.851	1.857	1.863	1.869	1.875	1.882	1.888	1.894	1.900	1.906	1.912	610
620	1.912	1.918	1.924	1.931	1.937	1.943	1.949	1.955	1.961	1.968	1.974	620
630	1.974	1.980	1.986	1.993	1.999	2.005	2.011	2.018	2.024	2.030	2.036	630
640	2.036	2.043	2.049	2.055	2.062	2.068	2.074	2.081	2.087	2.094	2.100	640
650	2.100	2.106	2.113	2.119	2.126	2.132	2.139	2.145	2.151	2.158	2.164	650
660	2.164	2.171	2.177	2.184	2.190	2.197	2.203	2.210	2.216	2.223	2.230	660
670	2.230	2.236	2.243	2.249	2.256	2.263	2.269	2.276	2.282	2.289	2.296	670
680	2.296	2.302	2.309	2.316	2.322	2.329	2.336	2.343	2.349	2.356	2.363	680
690	2.363	2.369	2.376	2.383	2.390	2.396	2.403	2.410	2.417	2.424	2.430	690
700	2.430	2.437	2.444	2.451	2.458	2.465	2.472	2.478	2.485	2.492	2.499	700
710	2.499	2.506	2.513	2.520	2.527	2.534	2.541	2.548	2.555	2.562	2.569	710
720	2.569	2.576	2.583	2.590	2.597	2.604	2.611	2.618	2.625	2.632	2.639	720
730	2.639	2.646	2.653	2.660	2.667	2.674	2.682	2.689	2.696	2.703	2.710	730
740	2.710	2.717	2.724	2.732	2.739	2.746	2.753	2.760	2.768	2.775	2.782	740
750	2.782	2.789	2.797	2.804	2.811	2.818	2.826	2.833	2.840	2.848	2.855	750
760	2.855	2.862	2.869	2.877	2.884	2.892	2.899	2.906	2.914	2.921	2.928	760
770	2.928	2.936	2.943	2.951	2.958	2.966	2.973	2.980	2.988	2.995	3.003	770
780	3.003	3.010	3.018	3.025	3.033	3.040	3.048	3.055	3.063	3.070	3.078	780
790	3.078	3.086	3.093	3.101	3.108	3.116	3.124	3.131	3.139	3.146	3.154	790
800	3.154	3.162	3.169	3.177	3.185	3.192	3.200	3.208	3.215	3.223	3.231	800
810	3.231	3.239	3.246	3.254	3.262	3.269	3.277	3.285	3.293	3.301	3.308	810
820	3.308	3.316	3.324	3.332	3.340	3.347	3.355	3.363	3.371	3.379	3.387	820
830	3.387	3.395	3.402	3.410	3.418	3.426	3.434	3.442	3.450	3.458	3.466	830
840	3.466	3.474	3.482	3.490	3.498	3.506	3.514	3.522	3.530	3.538	3.546	840
850	3.546	3.554	3.562	3.570	3.578	3.586	3.594	3.602	3.610	3.618	3.626	850
860	3.626	3.634	3.643	3.651	3.659	3.667	3.675	3.683	3.691	3.700	3.708	860
870	3.708	3.716	3.724	3.732	3.741	3.749	3.757	3.765	3.773	3.782	3.790	870
880	3.790	3.798	3.806	3.815	3.823	3.831	3.840	3.848	3.856	3.865	3.873	880
890	3.873	3.881	3.890	3.898	3.906	3.915	3.923	3.931	3.940	3.948	3.957	890
900	3.957	3.965	3.973	3.982	3.990	3.999	4.007	4.016	4.024	4.032	4.041	900
910	4.041	4.049	4.058	4.066	4.075	4.083	4.092	4.100	4.109	4.117	4.126	910
920	4.126	4.135	4.143	4.152	4.160	4.169	4.177	4.186	4.195	4.203	4.212	920
930	4.212	4.220	4.229	4.238	4.246	4.255	4.264	4.272	4.281	4.290	4.298	930
940	4.298	4.307	4.316	4.325	4.333	4.342	4.351	4.359	4.368	4.377	4.386	940
950	4.386	4.394	4.403	4.412	4.421	4.430	4.438	4.447	4.456	4.465	4.474	950
960	4.474	4.483	4.491	4.500	4.509	4.518	4.527	4.536	4.545	4.553	4.562	960
970	4.562	4.571	4.580	4.589	4.598	4.607	4.616	4.625	4.634	4.643	4.652	970
980	4.652	4.661	4.670	4.679	4.688	4.697	4.706	4.715	4.724	4.733	4.742	980
990	4.742	4.751	4.760	4.769	4.778	4.787	4.796	4.805	4.814	4.824	4.833	990
1,000	4.833	4.842	4.851	4.860	4.869	4.878	4.887	4.897	4.906	4.915	4.924	1,000
1,010	4.924	4.933	4.942	4.952	4.961	4.970	4.979	4.989	4.998	5.007	5.016	1,010
1,020	5.016	5.025	5.035	5.044	5.053	5.063	5.072	5.081	5.090	5.100	5.109	1,020
1,030	5.109	5.118	5.128	5.137	5.146	5.156	5.165	5.174	5.184	5.193	5.202	1,030
1,040	5.202	5.212	5.221	5.231	5.240	5.249	5.259	5.268	5.278	5.287	5.297	1,040
1,050	5.297	5.306	5.316	5.325	5.334	5.344	5.353	5.363	5.372	5.382	5.391	1,050
1,060	5.391	5.401	5.410	5.420	5.429	5.439	5.449	5.458	5.468	5.477	5.487	1,060
1,070	5.487	5.496	5.506	5.516	5.525	5.535	5.544	5.554	5.564	5.573	5.583	1,070
1,080	5.583	5.593	5.602	5.612	5.621	5.631	5.641	5.651	5.660	5.670	5.680	1,080
1,090	5.680	5.689	5.699	5.709	5.718	5.728	5.738	5.748	5.757	5.767	5.777	1,090
1,100	5.777	5.787	5.796	5.806	5.816	5.826	5.836	5.845	5.855	5.865	5.875	1,100
1,110	5.875	5.885	5.895	5.904	5.914	5.924	5.934	5.944	5.954	5.964	5.973	1,110
1,120	5.973	5.983	5.993	6.003	6.013	6.023	6.033	6.043	6.053	6.063	6.073	1,120
1,130	6.073	6.083	6.093	6.102	6.112	6.122	6.132	6.142	6.152	6.162	6.172	1,130
1,140	6.172	6.182	6.192	6.202	6.212	6.223	6.233	6.243	6.253	6.263	6.273	1,140
1,150	6.273	6.283	6.293	6.303	6.313	6.323	6.333	6.343	6.353	6.364	6.374	1,150
1,160	6.374	6.384	6.394	6.404	6.414	6.424	6.435	6.445	6.455	6.465	6.475	1,160
1,170	6.475	6.485	6.496	6.506	6.516	6.526	6.536	6.547	6.557	6.567	6.577	1,170
1,180	6.577	6.588	6.598	6.608	6.618	6.629	6.639	6.649	6.659	6.670	6.680	1,180
1,190	6.680	6.690	6.701	6.711	6.721	6.732	6.742	6.752	6.763	6.773	6.783	1,190
1,200	6.783	6.794	6.804	6.814	6.825	6.835	6.846	6.856	6.866	6.877	6.887	1,200
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A4.1.1. *Type B thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C—Continued*

°C	0	1	2	3	4	5	6	7	8	9	10	°C
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,200	6.783	6.794	6.804	6.814	6.825	6.835	6.846	6.856	6.866	6.877	6.887	1,200
1,210	6.887	6.898	6.908	6.918	6.929	6.939	6.950	6.960	6.971	6.981	6.991	1,210
1,220	6.991	7.002	7.012	7.023	7.033	7.044	7.054	7.065	7.075	7.086	7.096	1,220
1,230	7.096	7.107	7.117	7.128	7.138	7.149	7.159	7.170	7.181	7.191	7.202	1,230
1,240	7.202	7.212	7.223	7.233	7.244	7.255	7.265	7.276	7.286	7.297	7.308	1,240
1,250	7.308	7.318	7.329	7.339	7.350	7.361	7.371	7.382	7.393	7.403	7.414	1,250
1,260	7.414	7.425	7.435	7.446	7.457	7.467	7.478	7.489	7.500	7.510	7.521	1,260
1,270	7.521	7.532	7.542	7.553	7.564	7.575	7.585	7.596	7.607	7.618	7.628	1,270
1,280	7.628	7.639	7.650	7.661	7.671	7.682	7.693	7.704	7.715	7.725	7.736	1,280
1,290	7.736	7.747	7.758	7.769	7.780	7.790	7.801	7.812	7.823	7.834	7.845	1,290
1,300	7.845	7.855	7.866	7.877	7.888	7.899	7.910	7.921	7.932	7.943	7.953	1,300
1,310	7.953	7.964	7.975	7.986	7.997	8.008	8.019	8.030	8.041	8.052	8.063	1,310
1,320	8.063	8.074	8.085	8.096	8.107	8.118	8.128	8.139	8.150	8.161	8.172	1,320
1,330	8.172	8.183	8.194	8.205	8.216	8.227	8.238	8.249	8.261	8.272	8.283	1,330
1,340	8.283	8.294	8.305	8.316	8.327	8.338	8.349	8.360	8.371	8.382	8.393	1,340
1,350	8.393	8.404	8.415	8.426	8.437	8.449	8.460	8.471	8.482	8.493	8.504	1,350
1,360	8.504	8.515	8.526	8.538	8.549	8.560	8.571	8.582	8.593	8.604	8.616	1,360
1,370	8.616	8.627	8.638	8.649	8.660	8.671	8.683	8.694	8.705	8.716	8.727	1,370
1,380	8.727	8.738	8.750	8.761	8.772	8.783	8.795	8.806	8.817	8.828	8.839	1,380
1,390	8.839	8.851	8.862	8.873	8.884	8.896	8.907	8.918	8.929	8.941	8.952	1,390
1,400	8.952	8.963	8.974	8.986	8.997	9.008	9.020	9.031	9.042	9.053	9.065	1,400
1,410	9.065	9.076	9.087	9.099	9.110	9.121	9.133	9.144	9.155	9.167	9.178	1,410
1,420	9.178	9.189	9.201	9.212	9.223	9.235	9.246	9.257	9.269	9.280	9.291	1,420
1,430	9.291	9.303	9.314	9.326	9.337	9.348	9.360	9.371	9.382	9.394	9.405	1,430
1,440	9.405	9.417	9.428	9.439	9.451	9.462	9.474	9.485	9.497	9.508	9.519	1,440
1,450	9.519	9.531	9.542	9.554	9.565	9.577	9.588	9.599	9.611	9.622	9.634	1,450
1,460	9.634	9.645	9.657	9.668	9.680	9.691	9.703	9.714	9.726	9.737	9.748	1,460
1,470	9.748	9.760	9.771	9.783	9.794	9.806	9.817	9.829	9.840	9.852	9.863	1,470
1,480	9.863	9.875	9.886	9.898	9.909	9.921	9.933	9.944	9.956	9.967	9.979	1,480
1,490	9.979	9.990	10.002	10.013	10.025	10.036	10.048	10.059	10.071	10.082	10.094	1,490
1,500	10.094	10.106	10.117	10.129	10.140	10.152	10.163	10.175	10.187	10.198	10.210	1,500
1,510	10.210	10.221	10.233	10.244	10.256	10.268	10.279	10.291	10.302	10.314	10.325	1,510
1,520	10.325	10.337	10.349	10.360	10.372	10.383	10.395	10.407	10.418	10.430	10.441	1,520
1,530	10.441	10.453	10.465	10.476	10.488	10.500	10.511	10.523	10.534	10.546	10.558	1,530
1,540	10.558	10.569	10.581	10.593	10.604	10.616	10.627	10.639	10.651	10.662	10.674	1,540
1,550	10.674	10.686	10.697	10.709	10.721	10.732	10.744	10.756	10.767	10.779	10.790	1,550
1,560	10.790	10.802	10.814	10.825	10.837	10.849	10.860	10.872	10.884	10.895	10.907	1,560
1,570	10.907	10.919	10.930	10.942	10.954	10.965	10.977	10.989	11.000	11.012	11.024	1,570
1,580	11.024	11.035	11.047	11.059	11.070	11.082	11.094	11.105	11.117	11.129	11.141	1,580
1,590	11.141	11.152	11.164	11.176	11.187	11.199	11.211	11.222	11.234	11.246	11.257	1,590
1,600	11.257	11.269	11.281	11.292	11.304	11.316	11.328	11.339	11.351	11.363	11.374	1,600
1,610	11.374	11.386	11.398	11.409	11.421	11.433	11.444	11.456	11.468	11.480	11.491	1,610
1,620	11.491	11.503	11.515	11.526	11.538	11.550	11.561	11.573	11.585	11.597	11.608	1,620
1,630	11.608	11.620	11.632	11.643	11.655	11.667	11.678	11.690	11.702	11.714	11.725	1,630
1,640	11.725	11.737	11.749	11.760	11.772	11.784	11.795	11.807	11.819	11.830	11.842	1,640
1,650	11.842	11.854	11.866	11.877	11.889	11.901	11.912	11.924	11.936	11.947	11.959	1,650
1,660	11.959	11.971	11.983	11.994	12.006	12.018	12.029	12.041	12.053	12.064	12.076	1,660
1,670	12.076	12.088	12.099	12.111	12.123	12.134	12.146	12.158	12.170	12.181	12.193	1,670
1,680	12.193	12.205	12.216	12.228	12.240	12.251	12.263	12.275	12.286	12.298	12.310	1,680
1,690	12.310	12.321	12.333	12.345	12.356	12.368	12.380	12.391	12.403	12.415	12.426	1,690
1,700	12.426	12.438	12.450	12.461	12.473	12.485	12.496	12.508	12.520	12.531	12.543	1,700
1,710	12.543	12.555	12.566	12.578	12.590	12.601	12.613	12.624	12.636	12.648	12.659	1,710
1,720	12.659	12.671	12.683	12.694	12.706	12.718	12.729	12.741	12.752	12.764	12.776	1,720
1,730	12.776	12.787	12.799	12.811	12.822	12.834	12.845	12.857	12.869	12.880	12.892	1,730
1,740	12.892	12.903	12.915	12.927	12.938	12.950	12.961	12.973	12.985	12.996	13.008	1,740
1,750	13.008	13.019	13.031	13.043	13.054	13.066	13.077	13.089	13.100	13.112	13.124	1,750
1,760	13.124	13.135	13.147	13.158	13.170	13.181	13.193	13.204	13.216	13.228	13.239	1,760
1,770	13.239	13.251	13.262	13.274	13.285	13.297	13.308	13.320	13.331	13.343	13.354	1,770
1,780	13.354	13.366	13.378	13.389	13.401	13.412	13.424	13.435	13.447	13.458	13.470	1,780
1,790	13.470	13.481	13.493	13.504	13.516	13.527	13.539	13.550	13.562	13.573	13.585	1,790
1,800	13.585	13.596	13.607	13.619	13.630	13.642	13.653	13.665	13.676	13.688	13.699	1,800
1,810	13.699	13.711	13.722	13.733	13.745	13.756	13.768	13.779	13.791	13.802	13.814	1,810
1,820	13.814											1,820
°C	0	1	2	3	4	5	6	7	8	9	10	°C

TABLE A4.1.2. Type B thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F

$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0												0
10												10
20												20
30			0.000	-0.000	-0.000	-0.000	-0.001	-0.001	-0.001	-0.001	-0.001	30
40	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.002	-0.002	-0.002	-0.002	40
50	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	50
60	-0.002	-0.002	-0.002	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	60
70	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.002	-0.002	-0.002	-0.002	70
80	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	80
90	-0.002	-0.002	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	90
100	-0.001	-0.001	-0.001	-0.001	-0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000	100
110	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	110
120	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.004	0.004	120
130	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006	130
140	0.006	0.006	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.009	0.009	140
150	0.009	0.009	0.009	0.010	0.010	0.010	0.011	0.011	0.011	0.012	0.012	150
160	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.014	0.015	0.015	0.015	160
170	0.015	0.016	0.016	0.016	0.017	0.017	0.017	0.018	0.018	0.019	0.019	170
180	0.019	0.019	0.020	0.020	0.021	0.021	0.021	0.022	0.022	0.023	0.023	180
190	0.023	0.023	0.024	0.024	0.025	0.025	0.026	0.026	0.027	0.027	0.027	190
200	0.027	0.028	0.028	0.029	0.029	0.030	0.030	0.031	0.031	0.032	0.032	200
210	0.032	0.033	0.033	0.034	0.034	0.035	0.035	0.036	0.036	0.037	0.037	210
220	0.037	0.038	0.038	0.039	0.039	0.040	0.041	0.041	0.042	0.042	0.043	220
230	0.043	0.043	0.044	0.044	0.045	0.046	0.046	0.047	0.047	0.048	0.049	230
240	0.049	0.049	0.050	0.050	0.051	0.052	0.052	0.053	0.053	0.054	0.055	240
250	0.055	0.055	0.056	0.057	0.057	0.058	0.058	0.059	0.060	0.060	0.061	250
260	0.061	0.062	0.062	0.063	0.064	0.064	0.065	0.066	0.067	0.067	0.068	260
270	0.068	0.069	0.069	0.070	0.071	0.071	0.072	0.073	0.074	0.074	0.075	270
280	0.075	0.076	0.077	0.077	0.078	0.079	0.080	0.080	0.081	0.082	0.083	280
290	0.083	0.083	0.084	0.085	0.086	0.086	0.087	0.088	0.089	0.090	0.090	290
300	0.090	0.091	0.092	0.093	0.094	0.094	0.095	0.096	0.097	0.098	0.099	300
310	0.099	0.099	0.100	0.101	0.102	0.103	0.104	0.104	0.105	0.106	0.107	310
320	0.107	0.108	0.109	0.110	0.111	0.111	0.112	0.113	0.114	0.115	0.116	320
330	0.116	0.117	0.118	0.119	0.120	0.120	0.121	0.122	0.123	0.124	0.125	330
340	0.125	0.126	0.127	0.128	0.129	0.130	0.131	0.132	0.133	0.134	0.135	340
350	0.135	0.136	0.137	0.138	0.138	0.139	0.140	0.141	0.142	0.143	0.144	350
360	0.144	0.145	0.146	0.147	0.148	0.149	0.151	0.152	0.153	0.154	0.155	360
370	0.155	0.156	0.157	0.158	0.159	0.160	0.161	0.162	0.163	0.164	0.165	370
380	0.165	0.166	0.167	0.168	0.169	0.171	0.172	0.173	0.174	0.175	0.176	380
390	0.176	0.177	0.178	0.179	0.180	0.182	0.183	0.184	0.185	0.186	0.187	390
400	0.187	0.188	0.189	0.191	0.192	0.193	0.194	0.195	0.196	0.197	0.199	400
410	0.199	0.200	0.201	0.202	0.203	0.205	0.206	0.207	0.208	0.209	0.210	410
420	0.210	0.212	0.213	0.214	0.215	0.217	0.218	0.219	0.220	0.221	0.223	420
430	0.223	0.224	0.225	0.226	0.228	0.229	0.230	0.231	0.233	0.234	0.235	430
440	0.235	0.236	0.238	0.239	0.240	0.242	0.243	0.244	0.245	0.247	0.248	440
450	0.248	0.249	0.251	0.252	0.253	0.254	0.256	0.257	0.258	0.260	0.261	450
460	0.261	0.262	0.264	0.265	0.266	0.268	0.269	0.271	0.272	0.273	0.275	460
470	0.275	0.276	0.277	0.279	0.280	0.281	0.283	0.284	0.286	0.287	0.288	470
480	0.288	0.290	0.291	0.293	0.294	0.295	0.297	0.298	0.300	0.301	0.303	480
490	0.303	0.304	0.305	0.307	0.308	0.310	0.311	0.313	0.314	0.315	0.317	490
500	0.317	0.318	0.320	0.321	0.323	0.324	0.326	0.327	0.329	0.330	0.332	500
510	0.332	0.333	0.335	0.336	0.338	0.339	0.341	0.342	0.344	0.345	0.347	510
520	0.347	0.348	0.350	0.351	0.353	0.355	0.356	0.358	0.359	0.361	0.362	520
530	0.362	0.364	0.365	0.367	0.369	0.370	0.372	0.373	0.375	0.376	0.378	530
540	0.378	0.380	0.381	0.383	0.384	0.386	0.388	0.389	0.391	0.392	0.394	540
550	0.394	0.396	0.397	0.399	0.401	0.402	0.404	0.405	0.407	0.409	0.410	550
560	0.410	0.412	0.414	0.415	0.417	0.419	0.420	0.422	0.424	0.425	0.427	560
570	0.427	0.429	0.431	0.432	0.434	0.436	0.437	0.439	0.441	0.442	0.444	570
580	0.444	0.446	0.448	0.449	0.451	0.453	0.455	0.456	0.458	0.460	0.462	580
590	0.462	0.463	0.465	0.467	0.469	0.470	0.472	0.474	0.476	0.477	0.479	590
600	0.479	0.481	0.483	0.485	0.486	0.488	0.490	0.492	0.494	0.495	0.497	600
$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$

TABLE A4.1.2. *Type B thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	0.479	0.481	0.483	0.485	0.486	0.488	0.490	0.492	0.494	0.495	0.497	600
610	0.497	0.499	0.501	0.503	0.504	0.506	0.508	0.510	0.512	0.514	0.515	610
620	0.515	0.517	0.519	0.521	0.523	0.525	0.527	0.528	0.530	0.532	0.534	620
630	0.534	0.536	0.538	0.540	0.542	0.544	0.545	0.547	0.549	0.551	0.553	630
640	0.553	0.555	0.557	0.559	0.561	0.563	0.565	0.566	0.568	0.570	0.572	640
650	0.572	0.574	0.576	0.578	0.580	0.582	0.584	0.586	0.588	0.590	0.592	650
660	0.592	0.594	0.596	0.598	0.600	0.602	0.604	0.606	0.608	0.610	0.612	660
670	0.612	0.614	0.616	0.618	0.620	0.622	0.624	0.626	0.628	0.630	0.632	670
680	0.632	0.634	0.636	0.638	0.640	0.642	0.644	0.646	0.648	0.650	0.652	680
690	0.652	0.654	0.656	0.659	0.661	0.663	0.665	0.667	0.669	0.671	0.673	690
700	0.673	0.675	0.677	0.679	0.682	0.684	0.686	0.688	0.690	0.692	0.694	700
710	0.694	0.696	0.699	0.701	0.703	0.705	0.707	0.709	0.711	0.714	0.716	710
720	0.716	0.718	0.720	0.722	0.724	0.727	0.729	0.731	0.733	0.735	0.737	720
730	0.737	0.740	0.742	0.744	0.746	0.748	0.751	0.753	0.755	0.757	0.759	730
740	0.759	0.762	0.764	0.766	0.768	0.771	0.773	0.775	0.777	0.780	0.782	740
750	0.782	0.784	0.786	0.789	0.791	0.793	0.795	0.798	0.800	0.802	0.804	750
760	0.804	0.807	0.809	0.811	0.814	0.816	0.818	0.821	0.823	0.825	0.827	760
770	0.827	0.830	0.832	0.834	0.837	0.839	0.841	0.844	0.846	0.848	0.851	770
780	0.851	0.853	0.855	0.858	0.860	0.862	0.865	0.867	0.870	0.872	0.874	780
790	0.874	0.877	0.879	0.881	0.884	0.886	0.889	0.891	0.893	0.896	0.898	790
800	0.898	0.901	0.903	0.905	0.908	0.910	0.913	0.915	0.918	0.920	0.922	800
810	0.922	0.925	0.927	0.930	0.932	0.935	0.937	0.939	0.942	0.944	0.947	810
820	0.947	0.949	0.952	0.954	0.957	0.959	0.962	0.964	0.967	0.969	0.972	820
830	0.972	0.974	0.977	0.979	0.982	0.984	0.987	0.989	0.992	0.994	0.997	830
840	0.997	0.999	1.002	1.004	1.007	1.009	1.012	1.014	1.017	1.020	1.022	840
850	1.022	1.025	1.027	1.030	1.032	1.035	1.037	1.040	1.043	1.045	1.048	850
860	1.048	1.050	1.053	1.056	1.058	1.061	1.063	1.066	1.069	1.071	1.074	860
870	1.074	1.076	1.079	1.082	1.084	1.087	1.090	1.092	1.095	1.097	1.100	870
880	1.100	1.103	1.105	1.108	1.111	1.113	1.116	1.119	1.121	1.124	1.127	880
890	1.127	1.129	1.132	1.135	1.137	1.140	1.143	1.145	1.148	1.151	1.153	890
900	1.153	1.156	1.159	1.162	1.164	1.167	1.170	1.172	1.175	1.178	1.181	900
910	1.181	1.183	1.186	1.189	1.192	1.194	1.197	1.200	1.203	1.205	1.208	910
920	1.208	1.211	1.214	1.216	1.219	1.222	1.225	1.228	1.230	1.233	1.236	920
930	1.236	1.239	1.241	1.244	1.247	1.250	1.253	1.255	1.258	1.261	1.264	930
940	1.264	1.267	1.270	1.272	1.275	1.278	1.281	1.284	1.287	1.289	1.292	940
950	1.292	1.295	1.298	1.301	1.304	1.307	1.309	1.312	1.315	1.318	1.321	950
960	1.321	1.324	1.327	1.330	1.332	1.335	1.338	1.341	1.344	1.347	1.350	960
970	1.350	1.353	1.356	1.359	1.361	1.364	1.367	1.370	1.373	1.376	1.379	970
980	1.379	1.382	1.385	1.388	1.391	1.394	1.397	1.400	1.403	1.406	1.409	980
990	1.409	1.411	1.414	1.417	1.420	1.423	1.426	1.429	1.432	1.435	1.438	990
1,000	1.438	1.441	1.444	1.447	1.450	1.453	1.456	1.459	1.462	1.465	1.468	1,000
1,010	1.468	1.471	1.474	1.477	1.480	1.483	1.487	1.490	1.493	1.496	1.499	1,010
1,020	1.499	1.502	1.505	1.508	1.511	1.514	1.517	1.520	1.523	1.526	1.529	1,020
1,030	1.529	1.532	1.536	1.539	1.542	1.545	1.548	1.551	1.554	1.557	1.560	1,030
1,040	1.560	1.563	1.566	1.570	1.573	1.576	1.579	1.582	1.585	1.588	1.591	1,040
1,050	1.591	1.595	1.598	1.601	1.604	1.607	1.610	1.613	1.617	1.620	1.623	1,050
1,060	1.623	1.626	1.629	1.632	1.636	1.639	1.642	1.645	1.648	1.652	1.655	1,060
1,070	1.655	1.658	1.661	1.664	1.668	1.671	1.674	1.677	1.680	1.684	1.687	1,070
1,080	1.687	1.690	1.693	1.696	1.700	1.703	1.706	1.709	1.713	1.716	1.719	1,080
1,090	1.719	1.722	1.726	1.729	1.732	1.735	1.739	1.742	1.745	1.748	1.752	1,090
1,100	1.752	1.755	1.758	1.762	1.765	1.768	1.771	1.775	1.778	1.781	1.785	1,100
1,110	1.785	1.788	1.791	1.795	1.798	1.801	1.804	1.808	1.811	1.814	1.818	1,110
1,120	1.818	1.821	1.824	1.828	1.831	1.834	1.838	1.841	1.844	1.848	1.851	1,120
1,130	1.851	1.855	1.858	1.861	1.865	1.868	1.871	1.875	1.878	1.882	1.885	1,130
1,140	1.885	1.888	1.892	1.895	1.898	1.902	1.905	1.909	1.912	1.915	1.919	1,140
1,150	1.919	1.922	1.926	1.929	1.933	1.936	1.939	1.943	1.946	1.950	1.953	1,150
1,160	1.953	1.957	1.960	1.963	1.967	1.970	1.974	1.977	1.981	1.984	1.988	1,160
1,170	1.988	1.991	1.995	1.998	2.002	2.005	2.009	2.012	2.015	2.019	2.022	1,170
1,180	2.022	2.026	2.029	2.033	2.036	2.040	2.043	2.047	2.051	2.054	2.058	1,180
1,190	2.058	2.061	2.065	2.068	2.072	2.075	2.079	2.082	2.086	2.089	2.093	1,190
1,200	2.093	2.096	2.100	2.104	2.107	2.111	2.114	2.118	2.121	2.125	2.128	1,200

°F	0	1	2	3	4	5	6	7	8	9	10	°F
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TABLE A4.1.2. Type B thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F —Continued

$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,200	2.093	2.096	2.100	2.104	2.107	2.111	2.114	2.118	2.121	2.125	2.128	1,200
1,210	2.128	2.132	2.136	2.139	2.143	2.146	2.150	2.154	2.157	2.161	2.164	1,210
1,220	2.164	2.168	2.172	2.175	2.179	2.182	2.186	2.190	2.193	2.197	2.201	1,220
1,230	2.201	2.204	2.208	2.211	2.215	2.219	2.222	2.226	2.230	2.233	2.237	1,230
1,240	2.237	2.241	2.244	2.248	2.252	2.255	2.259	2.263	2.266	2.270	2.274	1,240
1,250	2.274	2.277	2.281	2.285	2.288	2.292	2.296	2.299	2.303	2.307	2.311	1,250
1,260	2.311	2.314	2.318	2.322	2.325	2.329	2.333	2.337	2.340	2.344	2.348	1,260
1,270	2.348	2.351	2.355	2.359	2.363	2.366	2.370	2.374	2.378	2.381	2.385	1,270
1,280	2.385	2.389	2.393	2.396	2.400	2.404	2.408	2.412	2.415	2.419	2.423	1,280
1,290	2.423	2.427	2.430	2.434	2.438	2.442	2.446	2.449	2.453	2.457	2.461	1,290
1,300	2.461	2.465	2.469	2.472	2.476	2.480	2.484	2.488	2.491	2.495	2.499	1,300
1,310	2.499	2.503	2.507	2.511	2.515	2.518	2.522	2.526	2.530	2.534	2.538	1,310
1,320	2.538	2.542	2.545	2.549	2.553	2.557	2.561	2.565	2.569	2.573	2.576	1,320
1,330	2.576	2.580	2.584	2.588	2.592	2.596	2.600	2.604	2.608	2.612	2.615	1,330
1,340	2.615	2.619	2.623	2.627	2.631	2.635	2.639	2.643	2.647	2.651	2.655	1,340
1,350	2.655	2.659	2.663	2.667	2.670	2.674	2.678	2.682	2.686	2.690	2.694	1,350
1,360	2.694	2.698	2.702	2.706	2.710	2.714	2.718	2.722	2.726	2.730	2.734	1,360
1,370	2.734	2.738	2.742	2.746	2.750	2.754	2.758	2.762	2.766	2.770	2.774	1,370
1,380	2.774	2.778	2.782	2.786	2.790	2.794	2.798	2.802	2.806	2.810	2.814	1,380
1,390	2.814	2.818	2.822	2.826	2.830	2.835	2.839	2.843	2.847	2.851	2.855	1,390
1,400	2.855	2.859	2.863	2.867	2.871	2.875	2.879	2.883	2.887	2.892	2.896	1,400
1,410	2.896	2.900	2.904	2.908	2.912	2.916	2.920	2.924	2.928	2.933	2.937	1,410
1,420	2.937	2.941	2.945	2.949	2.953	2.957	2.961	2.966	2.970	2.974	2.978	1,420
1,430	2.978	2.982	2.986	2.990	2.995	2.999	3.003	3.007	3.011	3.015	3.019	1,430
1,440	3.019	3.024	3.028	3.032	3.036	3.040	3.045	3.049	3.053	3.057	3.061	1,440
1,450	3.061	3.065	3.070	3.074	3.078	3.082	3.086	3.091	3.095	3.099	3.103	1,450
1,460	3.103	3.107	3.112	3.116	3.120	3.124	3.129	3.133	3.137	3.141	3.146	1,460
1,470	3.146	3.150	3.154	3.158	3.163	3.167	3.171	3.175	3.180	3.184	3.188	1,470
1,480	3.188	3.192	3.197	3.201	3.205	3.209	3.214	3.218	3.222	3.227	3.231	1,480
1,490	3.231	3.235	3.239	3.244	3.248	3.252	3.257	3.261	3.265	3.269	3.274	1,490
1,500	3.274	3.278	3.282	3.287	3.291	3.295	3.300	3.304	3.308	3.313	3.317	1,500
1,510	3.317	3.321	3.326	3.330	3.334	3.339	3.343	3.347	3.352	3.356	3.361	1,510
1,520	3.361	3.365	3.369	3.374	3.378	3.382	3.387	3.391	3.395	3.400	3.404	1,520
1,530	3.404	3.409	3.413	3.417	3.422	3.426	3.431	3.435	3.439	3.444	3.448	1,530
1,540	3.448	3.453	3.457	3.461	3.466	3.470	3.475	3.479	3.484	3.488	3.492	1,540
1,550	3.492	3.497	3.501	3.506	3.510	3.515	3.519	3.523	3.528	3.532	3.537	1,550
1,560	3.537	3.541	3.546	3.550	3.555	3.559	3.564	3.568	3.573	3.577	3.581	1,560
1,570	3.581	3.586	3.590	3.595	3.599	3.604	3.608	3.613	3.617	3.622	3.626	1,570
1,580	3.626	3.631	3.635	3.640	3.644	3.649	3.653	3.658	3.662	3.667	3.672	1,580
1,590	3.672	3.676	3.681	3.685	3.690	3.694	3.699	3.703	3.708	3.712	3.717	1,590
1,600	3.717	3.721	3.726	3.731	3.735	3.740	3.744	3.749	3.753	3.758	3.762	1,600
1,610	3.762	3.767	3.772	3.776	3.781	3.785	3.790	3.795	3.799	3.804	3.808	1,610
1,620	3.808	3.813	3.818	3.822	3.827	3.831	3.836	3.841	3.845	3.850	3.854	1,620
1,630	3.854	3.859	3.864	3.868	3.873	3.877	3.882	3.887	3.891	3.896	3.901	1,630
1,640	3.901	3.905	3.910	3.915	3.919	3.924	3.929	3.933	3.938	3.943	3.947	1,640
1,650	3.947	3.952	3.957	3.961	3.966	3.971	3.975	3.980	3.985	3.989	3.994	1,650
1,660	3.994	3.999	4.003	4.008	4.013	4.017	4.022	4.027	4.031	4.036	4.041	1,660
1,670	4.041	4.046	4.050	4.055	4.060	4.064	4.069	4.074	4.079	4.083	4.088	1,670
1,680	4.088	4.093	4.098	4.102	4.107	4.112	4.117	4.121	4.126	4.131	4.136	1,680
1,690	4.136	4.140	4.145	4.150	4.155	4.159	4.164	4.169	4.174	4.178	4.183	1,690
1,700	4.183	4.188	4.193	4.198	4.202	4.207	4.212	4.217	4.221	4.226	4.231	1,700
1,710	4.231	4.236	4.241	4.245	4.250	4.255	4.260	4.265	4.269	4.274	4.279	1,710
1,720	4.279	4.284	4.289	4.294	4.298	4.303	4.308	4.313	4.318	4.323	4.327	1,720
1,730	4.327	4.332	4.337	4.342	4.347	4.352	4.357	4.361	4.366	4.371	4.376	1,730
1,740	4.376	4.381	4.386	4.391	4.395	4.400	4.405	4.410	4.415	4.420	4.425	1,740
1,750	4.425	4.430	4.435	4.439	4.444	4.449	4.454	4.459	4.464	4.469	4.474	1,750
1,760	4.474	4.479	4.484	4.488	4.493	4.498	4.503	4.508	4.513	4.518	4.523	1,760
1,770	4.523	4.528	4.533	4.538	4.543	4.548	4.552	4.557	4.562	4.567	4.572	1,770
1,780	4.572	4.577	4.582	4.587	4.592	4.597	4.602	4.607	4.612	4.617	4.622	1,780
1,790	4.622	4.627	4.632	4.637	4.642	4.647	4.652	4.657	4.662	4.667	4.672	1,790
1,800	4.672	4.677	4.682	4.687	4.692	4.697	4.702	4.707	4.712	4.717	4.722	1,800
$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$

TABLE A4.1.2. *Type B thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,800	4.672	4.677	4.682	4.687	4.692	4.697	4.702	4.707	4.712	4.717	4.722	1,800
1,810	4.722	4.727	4.732	4.737	4.742	4.747	4.752	4.757	4.762	4.767	4.772	1,810
1,820	4.772	4.777	4.782	4.787	4.792	4.797	4.802	4.807	4.812	4.817	4.823	1,820
1,830	4.823	4.828	4.833	4.838	4.843	4.848	4.853	4.858	4.863	4.868	4.873	1,830
1,840	4.873	4.878	4.883	4.888	4.894	4.899	4.904	4.909	4.914	4.919	4.924	1,840
1,850	4.924	4.929	4.934	4.939	4.945	4.950	4.955	4.960	4.965	4.970	4.975	1,850
1,860	4.975	4.980	4.985	4.991	4.996	5.001	5.006	5.011	5.016	5.021	5.027	1,860
1,870	5.027	5.032	5.037	5.042	5.047	5.052	5.057	5.063	5.068	5.073	5.078	1,870
1,880	5.078	5.083	5.088	5.094	5.099	5.104	5.109	5.114	5.119	5.125	5.130	1,880
1,890	5.130	5.135	5.140	5.145	5.150	5.156	5.161	5.166	5.171	5.176	5.182	1,890
1,900	5.182	5.187	5.192	5.197	5.202	5.208	5.213	5.218	5.223	5.229	5.234	1,900
1,910	5.234	5.239	5.244	5.249	5.255	5.260	5.265	5.270	5.276	5.281	5.286	1,910
1,920	5.286	5.291	5.297	5.302	5.307	5.312	5.318	5.323	5.328	5.333	5.339	1,920
1,930	5.339	5.344	5.349	5.354	5.360	5.365	5.370	5.376	5.381	5.386	5.391	1,930
1,940	5.391	5.397	5.402	5.407	5.413	5.418	5.423	5.428	5.434	5.439	5.444	1,940
1,950	5.444	5.450	5.455	5.460	5.466	5.471	5.476	5.482	5.487	5.492	5.497	1,950
1,960	5.497	5.503	5.508	5.513	5.519	5.524	5.529	5.535	5.540	5.545	5.551	1,960
1,970	5.551	5.556	5.561	5.567	5.572	5.578	5.583	5.588	5.594	5.599	5.604	1,970
1,980	5.604	5.610	5.615	5.620	5.626	5.631	5.637	5.642	5.647	5.653	5.658	1,980
1,990	5.658	5.663	5.669	5.674	5.680	5.685	5.690	5.696	5.701	5.707	5.712	1,990
2,000	5.712	5.717	5.723	5.728	5.734	5.739	5.744	5.750	5.755	5.761	5.766	2,000
2,010	5.766	5.771	5.777	5.782	5.788	5.793	5.799	5.804	5.810	5.815	5.820	2,010
2,020	5.820	5.826	5.831	5.837	5.842	5.848	5.853	5.859	5.864	5.869	5.875	2,020
2,030	5.875	5.880	5.886	5.891	5.897	5.902	5.908	5.913	5.919	5.924	5.930	2,030
2,040	5.930	5.935	5.941	5.946	5.951	5.957	5.962	5.968	5.973	5.979	5.984	2,040
2,050	5.984	5.990	5.995	6.001	6.006	6.012	6.017	6.023	6.028	6.034	6.039	2,050
2,060	6.039	6.045	6.051	6.056	6.062	6.067	6.073	6.078	6.084	6.089	6.095	2,060
2,070	6.095	6.100	6.106	6.111	6.117	6.122	6.128	6.134	6.139	6.145	6.150	2,070
2,080	6.150	6.156	6.161	6.167	6.172	6.178	6.184	6.189	6.195	6.200	6.206	2,080
2,090	6.206	6.211	6.217	6.223	6.228	6.234	6.239	6.245	6.250	6.256	6.262	2,090
2,100	6.262	6.267	6.273	6.278	6.284	6.290	6.295	6.301	6.306	6.312	6.318	2,100
2,110	6.318	6.323	6.329	6.334	6.340	6.346	6.351	6.357	6.362	6.368	6.374	2,110
2,120	6.374	6.379	6.385	6.391	6.396	6.402	6.408	6.413	6.419	6.424	6.430	2,120
2,130	6.430	6.436	6.441	6.447	6.453	6.458	6.464	6.470	6.475	6.481	6.487	2,130
2,140	6.487	6.492	6.498	6.504	6.509	6.515	6.521	6.526	6.532	6.538	6.543	2,140
2,150	6.543	6.549	6.555	6.560	6.566	6.572	6.577	6.583	6.589	6.594	6.600	2,150
2,160	6.600	6.606	6.612	6.617	6.623	6.629	6.634	6.640	6.646	6.651	6.657	2,160
2,170	6.657	6.663	6.669	6.674	6.680	6.686	6.692	6.697	6.703	6.709	6.714	2,170
2,180	6.714	6.720	6.726	6.732	6.737	6.743	6.749	6.755	6.760	6.766	6.772	2,180
2,190	6.772	6.778	6.783	6.789	6.795	6.801	6.806	6.812	6.818	6.824	6.829	2,190
2,200	6.829	6.835	6.841	6.847	6.852	6.858	6.864	6.870	6.876	6.881	6.887	2,200
2,210	6.887	6.893	6.899	6.904	6.910	6.916	6.922	6.928	6.933	6.939	6.945	2,210
2,220	6.945	6.951	6.957	6.962	6.968	6.974	6.980	6.986	6.991	6.997	7.003	2,220
2,230	7.003	7.009	7.015	7.021	7.026	7.032	7.038	7.044	7.050	7.055	7.061	2,230
2,240	7.061	7.067	7.073	7.079	7.085	7.090	7.096	7.102	7.108	7.114	7.120	2,240
2,250	7.120	7.126	7.131	7.137	7.143	7.149	7.155	7.161	7.167	7.172	7.178	2,250
2,260	7.178	7.184	7.190	7.196	7.202	7.208	7.213	7.219	7.225	7.231	7.237	2,260
2,270	7.237	7.243	7.249	7.255	7.260	7.266	7.272	7.278	7.284	7.290	7.296	2,270
2,280	7.296	7.302	7.308	7.314	7.319	7.325	7.331	7.337	7.343	7.349	7.355	2,280
2,290	7.355	7.361	7.367	7.373	7.378	7.384	7.390	7.396	7.402	7.408	7.414	2,290
2,300	7.414	7.420	7.426	7.432	7.438	7.444	7.450	7.456	7.461	7.467	7.473	2,300
2,310	7.473	7.479	7.485	7.491	7.497	7.503	7.509	7.515	7.521	7.527	7.533	2,310
2,320	7.533	7.539	7.545	7.551	7.557	7.563	7.569	7.575	7.581	7.587	7.592	2,320
2,330	7.592	7.598	7.604	7.610	7.616	7.622	7.628	7.634	7.640	7.646	7.652	2,330
2,340	7.652	7.658	7.664	7.670	7.676	7.682	7.688	7.694	7.700	7.706	7.712	2,340
2,350	7.712	7.718	7.724	7.730	7.736	7.742	7.748	7.754	7.760	7.766	7.772	2,350
2,360	7.772	7.778	7.784	7.790	7.796	7.802	7.808	7.814	7.820	7.827	7.833	2,360
2,370	7.833	7.839	7.845	7.851	7.857	7.863	7.869	7.875	7.881	7.887	7.893	2,370
2,380	7.893	7.899	7.905	7.911	7.917	7.923	7.929	7.935	7.941	7.947	7.953	2,380
2,390	7.953	7.959	7.966	7.972	7.978	7.984	7.990	7.996	8.002	8.008	8.014	2,390
2,400	8.014	8.020	8.026	8.032	8.038	8.044	8.051	8.057	8.063	8.069	8.075	2,400
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A4.1.2. *Type B thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
2,400	8.014	8.020	8.026	8.032	8.038	8.044	8.051	8.057	8.063	8.069	8.075	2,400
2,410	8.075	8.081	8.087	8.093	8.099	8.105	8.111	8.118	8.124	8.130	8.136	2,410
2,420	8.136	8.142	8.148	8.154	8.160	8.166	8.172	8.179	8.185	8.191	8.197	2,420
2,430	8.197	8.203	8.209	8.215	8.221	8.227	8.234	8.240	8.246	8.252	8.258	2,430
2,440	8.258	8.264	8.270	8.276	8.283	8.289	8.295	8.301	8.307	8.313	8.319	2,440
2,450	8.319	8.326	8.332	8.338	8.344	8.350	8.356	8.362	8.369	8.375	8.381	2,450
2,460	8.381	8.387	8.393	8.399	8.405	8.412	8.418	8.424	8.430	8.436	8.442	2,460
2,470	8.442	8.449	8.455	8.461	8.467	8.473	8.479	8.486	8.492	8.498	8.504	2,470
2,480	8.504	8.510	8.516	8.522	8.529	8.535	8.541	8.547	8.554	8.560	8.566	2,480
2,490	8.566	8.572	8.578	8.585	8.591	8.597	8.603	8.609	8.616	8.622	8.628	2,490
2,500	8.628	8.634	8.640	8.647	8.653	8.659	8.665	8.671	8.678	8.684	8.690	2,500
2,510	8.690	8.696	8.702	8.709	8.715	8.721	8.727	8.733	8.740	8.746	8.752	2,510
2,520	8.752	8.758	8.765	8.771	8.777	8.783	8.790	8.796	8.802	8.808	8.814	2,520
2,530	8.814	8.821	8.827	8.833	8.839	8.846	8.852	8.858	8.864	8.871	8.877	2,530
2,540	8.877	8.883	8.889	8.896	8.902	8.908	8.914	8.921	8.927	8.933	8.939	2,540
2,550	8.939	8.946	8.952	8.958	8.964	8.971	8.977	8.983	8.989	8.996	9.002	2,550
2,560	9.002	9.008	9.015	9.021	9.027	9.033	9.040	9.046	9.052	9.058	9.065	2,560
2,570	9.065	9.071	9.077	9.084	9.090	9.096	9.102	9.109	9.115	9.121	9.128	2,570
2,580	9.128	9.134	9.140	9.146	9.153	9.159	9.165	9.172	9.178	9.184	9.191	2,580
2,590	9.191	9.197	9.203	9.209	9.216	9.222	9.228	9.235	9.241	9.247	9.254	2,590
2,600	9.254	9.260	9.266	9.273	9.279	9.285	9.291	9.298	9.304	9.310	9.317	2,600
2,610	9.317	9.323	9.329	9.336	9.342	9.348	9.355	9.361	9.367	9.374	9.380	2,610
2,620	9.380	9.386	9.393	9.399	9.405	9.412	9.418	9.424	9.431	9.437	9.443	2,620
2,630	9.443	9.450	9.456	9.462	9.469	9.475	9.481	9.488	9.494	9.500	9.507	2,630
2,640	9.507	9.513	9.519	9.526	9.532	9.538	9.545	9.551	9.558	9.564	9.570	2,640
2,650	9.570	9.577	9.583	9.589	9.596	9.602	9.608	9.615	9.621	9.627	9.634	2,650
2,660	9.634	9.640	9.647	9.653	9.659	9.666	9.672	9.678	9.685	9.691	9.697	2,660
2,670	9.697	9.704	9.710	9.717	9.723	9.729	9.736	9.742	9.748	9.755	9.761	2,670
2,680	9.761	9.768	9.774	9.780	9.787	9.793	9.800	9.806	9.812	9.819	9.825	2,680
2,690	9.825	9.831	9.838	9.844	9.851	9.857	9.863	9.870	9.876	9.883	9.889	2,690
2,700	9.889	9.895	9.902	9.908	9.915	9.921	9.927	9.934	9.940	9.947	9.953	2,700
2,710	9.953	9.959	9.966	9.972	9.979	9.985	9.991	9.998	10.004	10.011	10.017	2,710
2,720	10.017	10.023	10.030	10.036	10.043	10.049	10.056	10.062	10.068	10.075	10.081	2,720
2,730	10.081	10.088	10.094	10.100	10.107	10.113	10.120	10.126	10.133	10.139	10.145	2,730
2,740	10.145	10.152	10.158	10.165	10.171	10.178	10.184	10.190	10.197	10.203	10.210	2,740
2,750	10.210	10.216	10.223	10.229	10.235	10.242	10.248	10.255	10.261	10.268	10.274	2,750
2,760	10.274	10.280	10.287	10.293	10.300	10.306	10.313	10.319	10.325	10.332	10.338	2,760
2,770	10.338	10.345	10.351	10.358	10.364	10.371	10.377	10.383	10.390	10.396	10.403	2,770
2,780	10.403	10.409	10.416	10.422	10.429	10.435	10.441	10.448	10.454	10.461	10.467	2,780
2,790	10.467	10.474	10.480	10.487	10.493	10.500	10.506	10.512	10.519	10.525	10.532	2,790
2,800	10.532	10.538	10.545	10.551	10.558	10.564	10.571	10.577	10.584	10.590	10.596	2,800
2,810	10.596	10.603	10.609	10.616	10.622	10.629	10.635	10.642	10.648	10.655	10.661	2,810
2,820	10.661	10.668	10.674	10.680	10.687	10.693	10.700	10.706	10.713	10.719	10.726	2,820
2,830	10.726	10.732	10.739	10.745	10.752	10.758	10.765	10.771	10.778	10.784	10.790	2,830
2,840	10.790	10.797	10.803	10.810	10.816	10.823	10.829	10.836	10.842	10.849	10.855	2,840
2,850	10.855	10.862	10.868	10.875	10.881	10.888	10.894	10.901	10.907	10.914	10.920	2,850
2,860	10.920	10.926	10.933	10.939	10.946	10.952	10.959	10.965	10.972	10.978	10.985	2,860
2,870	10.985	10.991	10.998	11.004	11.011	11.017	11.024	11.030	11.037	11.043	11.050	2,870
2,880	11.050	11.056	11.063	11.069	11.076	11.082	11.089	11.095	11.102	11.108	11.115	2,880
2,890	11.115	11.121	11.128	11.134	11.141	11.147	11.154	11.160	11.166	11.173	11.179	2,890
2,900	11.179	11.186	11.192	11.199	11.205	11.212	11.218	11.225	11.231	11.238	11.244	2,900
2,910	11.244	11.251	11.257	11.264	11.270	11.277	11.283	11.290	11.296	11.303	11.309	2,910
2,920	11.309	11.316	11.322	11.329	11.335	11.342	11.348	11.355	11.361	11.368	11.374	2,920
2,930	11.374	11.381	11.387	11.394	11.400	11.407	11.413	11.420	11.426	11.433	11.439	2,930
2,940	11.439	11.446	11.452	11.459	11.465	11.472	11.478	11.485	11.491	11.498	11.504	2,940
2,950	11.504	11.511	11.517	11.524	11.530	11.537	11.543	11.550	11.556	11.563	11.569	2,950
2,960	11.569	11.576	11.582	11.589	11.595	11.602	11.608	11.615	11.621	11.628	11.634	2,960
2,970	11.634	11.641	11.647	11.654	11.660	11.667	11.673	11.680	11.686	11.693	11.699	2,970
2,980	11.699	11.706	11.712	11.719	11.725	11.732	11.738	11.745	11.751	11.758	11.764	2,980
2,990	11.764	11.771	11.777	11.784	11.790	11.797	11.803	11.810	11.816	11.823	11.829	2,990
3,000	11.829	11.836	11.842	11.849	11.855	11.862	11.868	11.875	11.881	11.888	11.894	3,000

°F	0	1	2	3	4	5	6	7	8	9	10	°F
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TABLE A4.1.2. *Type B thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F —Continued*

$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
3,000	11.829	11.836	11.842	11.849	11.855	11.862	11.868	11.875	11.881	11.888	11.894	3,000
3,010	11.894	11.901	11.907	11.914	11.920	11.927	11.933	11.940	11.946	11.953	11.959	3,010
3,020	11.959	11.966	11.972	11.979	11.985	11.992	11.998	12.005	12.011	12.018	12.024	3,020
3,030	12.024	12.031	12.037	12.044	12.050	12.057	12.063	12.070	12.076	12.083	12.089	3,030
3,040	12.089	12.096	12.102	12.109	12.115	12.121	12.128	12.134	12.141	12.147	12.154	3,040
3,050	12.154	12.160	12.167	12.173	12.180	12.186	12.193	12.199	12.206	12.212	12.219	3,050
3,060	12.219	12.225	12.232	12.238	12.245	12.251	12.258	12.264	12.271	12.277	12.284	3,060
3,070	12.284	12.290	12.297	12.303	12.310	12.316	12.323	12.329	12.336	12.342	12.349	3,070
3,080	12.349	12.355	12.362	12.368	12.374	12.381	12.387	12.394	12.400	12.407	12.413	3,080
3,090	12.413	12.420	12.426	12.433	12.439	12.446	12.452	12.459	12.465	12.472	12.478	3,090
3,100	12.478	12.485	12.491	12.498	12.504	12.511	12.517	12.523	12.530	12.536	12.543	3,100
3,110	12.543	12.549	12.556	12.562	12.569	12.575	12.582	12.588	12.595	12.601	12.608	3,110
3,120	12.608	12.614	12.621	12.627	12.633	12.640	12.646	12.653	12.659	12.666	12.672	3,120
3,130	12.672	12.679	12.685	12.692	12.698	12.705	12.711	12.718	12.724	12.730	12.737	3,130
3,140	12.737	12.743	12.750	12.756	12.763	12.769	12.776	12.782	12.789	12.795	12.801	3,140
3,150	12.801	12.808	12.814	12.821	12.827	12.834	12.840	12.847	12.853	12.860	12.866	3,150
3,160	12.866	12.872	12.879	12.885	12.892	12.898	12.905	12.911	12.918	12.924	12.930	3,160
3,170	12.930	12.937	12.943	12.950	12.956	12.963	12.969	12.976	12.982	12.988	12.995	3,170
3,180	12.995	13.001	13.008	13.014	13.021	13.027	13.034	13.040	13.046	13.053	13.059	3,180
3,190	13.059	13.066	13.072	13.079	13.085	13.091	13.098	13.104	13.111	13.117	13.124	3,190
3,200	13.124	13.130	13.136	13.143	13.149	13.156	13.162	13.169	13.175	13.181	13.188	3,200
3,210	13.188	13.194	13.201	13.207	13.213	13.220	13.226	13.233	13.239	13.246	13.252	3,210
3,220	13.252	13.258	13.265	13.271	13.278	13.284	13.290	13.297	13.303	13.310	13.316	3,220
3,230	13.316	13.322	13.329	13.335	13.342	13.348	13.354	13.361	13.367	13.374	13.380	3,230
3,240	13.380	13.387	13.393	13.399	13.406	13.412	13.418	13.425	13.431	13.438	13.444	3,240
3,250	13.444	13.450	13.457	13.463	13.470	13.476	13.482	13.489	13.495	13.502	13.508	3,250
3,260	13.508	13.514	13.521	13.527	13.533	13.540	13.546	13.553	13.559	13.565	13.572	3,260
3,270	13.572	13.578	13.585	13.591	13.597	13.604	13.610	13.616	13.623	13.629	13.635	3,270
3,280	13.635	13.642	13.648	13.655	13.661	13.667	13.674	13.680	13.686	13.693	13.699	3,280
3,290	13.699	13.706	13.712	13.718	13.725	13.731	13.737	13.744	13.750	13.756	13.763	3,290
3,300	13.763	13.769	13.775	13.782	13.788	13.794	13.801	13.807	13.814			3,300
$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$

TABLE A4.1.3. *Type B thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature (°C) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius*

Temperature Range (°C)	a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (μV)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
0 - 900	.....		-2.3614224	-1	5.7496551	-3	-5.6339756	-7	-1.1808558	-10	-.22 to .14
0 - 1100	.....		-2.3893338	-1	5.7684447	-3	-5.9963692	-7	-9.7041131	-11	-.18 to .20
0 - 1400	.....		-2.3476301	-1	5.7480761	-3	-5.7165679	-7	-1.0838193	-10	-.7 to 1.0
0 - 1650	.....		-1.9185893	-1	5.5578879	-3	-3.3057924	-7	-2.0018428	-10	-.4 to .5
0 - 1820	.....		-1.3749133	-1	5.3446673	-3	-9.1094186	-8	-2.8098361	-10	-.8 to .9
400 - 1100	1.3740347	+1	-3.2914888	-1	5.9766638	-3	-8.0141311	-7	-2.7203972	-11	-.05 to .05
400 - 1400	-2.5321108	+1	-9.9736579	-2	5.4976533	-3	-3.7806912	-7	-1.6156824	-10	-.5 to .5
400 - 1650	-1.1708354	+2	3.9860894	-1	4.5539656	-3	3.6623964	-7	-3.6969100	-10	-.2 to 1.8
1050 - 1400	-9.8446259	+2	3.3670688	+0	8.2282215	-4	2.4061224	-6	-7.7901142	-10	-.05 to .05
1050 - 1650	-1.3702395	+3	4.6252371	+0	-7.0976836	-4	3.2325686	-6	-9.4548852	-10	-.05 to .05
1400 - 1550	-4.7644591	+2	2.2890832	+0	1.5749253	-3	2.2417410	-6	-7.8471224	-10	-.05 to .05
1400 - 1650	-6.4878929	+2	2.7380621	+0	1.1375302	-3	2.4305578	-6	-8.1518033	-10	-.05 to .05
II. Cubic Equation											
0 - 900	.....		-2.5317587	-1	5.8595708	-3	-7.6993335	-7	.....		-.7 to .8
0 - 1100	.....		-2.6449078	-1	5.9033779	-3	-8.0708265	-7	.....		-1.3 to 1.6
0 - 1400	.....		-2.9360992	-1	5.9921890	-3	-8.6653377	-7	.....		-.4 to .5
0 - 1650	.....		-3.6981779	-1	6.1841732	-3	-9.7245689	-7	.....		-.16 to .18
0 - 1820	.....		-4.6524167	-1	6.3971743	-3	-1.0764554	-6	.....		-.41 to .35
400 - 1100	2.0519281	+1	-3.7005530	-1	6.0651437	-3	-8.8302503	-7	.....		-.06 to .05
400 - 1400	4.9107124	+1	-4.9814127	-1	6.2424703	-3	-9.5971478	-7	.....		-1.6 to 1.8
400 - 1650	1.4540159	+2	-8.9700167	-1	6.7392477	-3	-1.1492674	-6	.....		-.9 to 1.0
1050 - 1400	7.3217157	+2	-2.2980245	+0	7.8092987	-3	-1.4100442	-6	.....		-.1 to .1
1050 - 1650	1.6159476	+3	-4.4499631	+0	9.5440282	-3	-1.8730694	-6	.....		-.9 to 1.1
1400 - 1550	3.2295446	+3	-7.7731451	+0	1.1815623	-2	-2.3884289	-6	.....		-.05 to .05
1400 - 1650	3.7286603	+3	-8.7838224	+0	1.2497228	-2	-2.5415245	-6	.....		-.05 to .05
Variable reference junction correction											
0 - 50	.....		-2.4673839	-1	5.9050303	-3	-1.2267180	-6	.....		-0.01 to +0.01
III. Quadratic Equation											
0 - 900	.....		2.2387544	-2	4.8870900	-3	.....		.....		-.23 to .21
0 - 1100	.....		1.6701517	-1	4.6574410	-3	.....		.....		-.43 to .40
0 - 1400	.....		4.5684562	-1	4.2896429	-3	.....		.....		-.100 to .90
0 - 1650	.....		7.9918543	-1	3.9331970	-3	.....		.....		-.190 to .170
0 - 1820	.....		1.0444861	+0	3.7094577	-3	.....		.....		-.380 to .230
400 - 1100	-2.9179161	+2	1.0397624	+0	4.0783374	-3	.....		.....		-.10 to .10
400 - 1400	-4.9025168	+2	1.6558842	+0	3.6512404	-3	.....		.....		-.33 to .31
400 - 1650	-7.4851082	+2	2.3875919	+0	3.2074630	-3	.....		.....		-.82 to .75
1050 - 1400	-1.8081022	+3	3.9965349	+0	2.6363196	-3	.....		.....		-.2.4 to 1.9
1050 - 1650	-2.8235913	+3	5.6659222	+0	1.9580971	-3	.....		.....		-.14 to .14
1400 - 1550	-4.4188889	+3	7.8036743	+0	1.2476459	-3	.....		.....		-.3 to .3
1400 - 1650	-5.2286970	+3	8.9036398	+0	8.7465276	-4	.....		.....		-.1.4 to 1.3
Variable reference junction correction											
0 - 50	.....		-2.4527938	-1	5.8110689	-3	.....		.....		-0.08 to +0.14

A4.2. Data for Temperature as a Function of Voltage

The temperature as a function of voltage data given in tables A4.2.1 and A4.2.2 were obtained by iteration in the primary equations for voltage as a function of temperature. Table A4.2.1 presents the data in millivolts from 0.0 mV to 13.81 mV with temperatures given in degrees Celsius while table A4.2.2 presents similar data with temperatures in degrees Fahrenheit. Table A4.2.3 contains quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges. The error range given in the table represents the difference between the temperature found by iteration in the full precision tables from the text and from the respective reduced order approximations.

TABLE A4.2.1. *Type B thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
0.00	42.15	67.74	83.69	96.38	107.25	116.92	125.72	133.85	141.45	148.61	155.39	0.00
0.10	155.39	161.86	168.05	174.00	179.74	185.28	190.64	195.85	200.91	205.84	210.64	0.10
0.20	210.64	215.33	219.91	224.40	228.79	233.09	237.32	241.46	245.53	249.53	253.47	0.20
0.30	253.47	257.34	261.15	264.91	268.61	272.26	275.86	279.42	282.92	286.38	289.80	0.30
0.40	289.80	293.18	296.52	299.83	303.09	306.32	309.52	312.68	315.81	318.91	321.98	0.40
0.50	321.98	325.02	328.03	331.01	333.97	336.90	339.81	342.69	345.55	348.38	351.19	0.50
0.60	351.19	353.98	356.75	359.49	362.22	364.92	367.61	370.27	372.92	375.55	378.16	0.60
0.70	378.16	380.75	383.33	385.88	388.43	390.95	393.46	395.96	398.43	400.90	403.35	0.70
0.80	403.35	405.78	408.20	410.61	413.00	415.38	417.75	420.10	422.44	424.77	427.09	0.80
0.90	427.09	429.39	431.68	433.96	436.23	438.49	440.73	442.97	445.19	447.41	449.61	0.90
1.00	449.61	451.80	453.99	456.16	458.32	460.48	462.62	464.75	466.88	468.99	471.10	1.00
1.10	471.10	473.20	475.29	477.37	479.44	481.50	483.56	485.60	487.64	489.67	491.70	1.10
1.20	491.70	493.71	495.72	497.72	499.71	501.69	503.67	505.64	507.60	509.56	511.51	1.20
1.30	511.51	513.45	515.38	517.31	519.23	521.15	523.06	524.96	526.85	528.74	530.63	1.30
1.40	530.63	532.50	534.37	536.24	538.10	539.95	541.79	543.64	545.47	547.30	549.12	1.40
1.50	549.12	550.94	552.75	554.56	556.36	558.16	559.95	561.74	563.52	565.29	567.06	1.50
1.60	567.06	568.83	570.59	572.35	574.10	575.84	577.58	579.32	581.05	582.78	584.50	1.60
1.70	584.50	586.22	587.93	589.64	591.34	593.04	594.74	596.43	598.12	599.80	601.48	1.70
1.80	601.48	603.15	604.82	606.48	608.15	609.80	611.46	613.11	614.75	616.39	618.03	1.80
1.90	618.03	619.66	621.29	622.92	624.54	626.16	627.77	629.38	630.99	632.59	634.19	1.90
2.00	634.19	635.79	637.38	638.97	640.56	642.14	643.72	645.30	646.87	648.44	650.00	2.00
2.10	650.00	651.56	653.12	654.68	656.23	657.78	659.33	660.87	662.41	663.94	665.48	2.10
2.20	665.48	667.01	668.53	670.06	671.58	673.10	674.61	676.12	677.63	679.14	680.64	2.20
2.30	680.64	682.14	683.64	685.13	686.63	688.12	689.60	691.08	692.57	694.04	695.52	2.30
2.40	695.52	696.99	698.46	699.93	701.39	702.85	704.31	705.77	707.22	708.68	710.12	2.40
2.50	710.12	711.57	713.01	714.46	715.89	717.33	718.76	720.20	721.63	723.05	724.48	2.50
2.60	724.48	725.90	727.32	728.73	730.15	731.56	732.97	734.38	735.78	737.19	738.59	2.60
2.70	738.59	739.99	741.38	742.78	744.17	745.56	746.95	748.33	749.72	751.10	752.48	2.70
2.80	752.48	753.85	755.23	756.60	757.97	759.34	760.70	762.07	763.43	764.79	766.15	2.80
2.90	766.15	767.50	768.86	770.21	771.56	772.91	774.26	775.60	776.94	778.28	779.62	2.90
3.00	779.62	780.96	782.29	783.62	784.96	786.28	787.61	788.94	790.26	791.58	792.90	3.00
3.10	792.90	794.22	795.54	796.85	798.16	799.47	800.78	802.09	803.39	804.70	806.00	3.10
3.20	806.00	807.30	808.60	809.89	811.19	812.48	813.77	815.06	816.35	817.64	818.92	3.20
3.30	818.92	820.21	821.49	822.77	824.05	825.32	826.60	827.87	829.15	830.42	831.68	3.30
3.40	831.68	832.95	834.22	835.48	836.74	838.01	839.26	840.52	841.78	843.03	844.29	3.40
3.50	844.29	845.54	846.79	848.04	849.29	850.53	851.78	853.02	854.26	855.50	856.74	3.50
3.60	856.74	857.98	859.21	860.45	861.68	862.91	864.14	865.37	866.60	867.82	869.05	3.60
3.70	869.05	870.27	871.49	872.71	873.93	875.15	876.36	877.58	878.79	880.01	881.22	3.70
3.80	881.22	882.43	883.63	884.84	886.05	887.25	888.46	889.66	890.86	892.06	893.25	3.80
3.90	893.25	894.45	895.65	896.84	898.03	899.22	900.42	901.60	902.79	903.98	905.16	3.90
4.00	905.16	906.35	907.53	908.71	909.89	911.07	912.25	913.43	914.60	915.78	916.95	4.00
4.10	916.95	918.12	919.30	920.47	921.63	922.80	923.97	925.13	926.30	927.46	928.62	4.10
4.20	928.62	929.78	930.94	932.10	933.26	934.42	935.57	936.73	937.88	939.03	940.18	4.20
4.30	940.18	941.33	942.48	943.63	944.77	945.92	947.06	948.21	949.35	950.49	951.63	4.30
4.40	951.63	952.77	953.91	955.04	956.18	957.32	958.45	959.58	960.71	961.84	962.97	4.40
4.50	962.97	964.10	965.23	966.36	967.48	968.61	969.73	970.85	971.98	973.10	974.22	4.50
4.60	974.22	975.34	976.45	977.57	978.69	979.80	980.92	982.03	983.14	984.25	985.36	4.60
4.70	985.36	986.47	987.58	988.69	989.79	990.90	992.00	993.11	994.21	995.31	996.41	4.70
4.80	996.41	997.51	998.61	999.71	1000.81	1001.90	1003.00	1004.09	1005.19	1006.28	1007.37	4.80
4.90	1007.37	1008.46	1009.55	1010.64	1011.73	1012.82	1013.91	1014.99	1016.08	1017.16	1018.24	4.90
5.00	1018.24	1019.33	1020.41	1021.49	1022.57	1023.65	1024.73	1025.80	1026.88	1027.96	1029.03	5.00
5.10	1029.03	1030.10	1031.18	1032.25	1033.32	1034.39	1035.46	1036.53	1037.60	1038.67	1039.73	5.10
5.20	1039.73	1040.80	1041.87	1042.93	1043.99	1045.06	1046.12	1047.18	1048.24	1049.30	1050.36	5.20
5.30	1050.36	1051.42	1052.47	1053.53	1054.59	1055.64	1056.69	1057.75	1058.80	1059.85	1060.90	5.30
5.40	1060.90	1061.95	1063.00	1064.05	1065.10	1066.15	1067.20	1068.25	1069.29	1070.33	1071.38	5.40
5.50	1071.38	1072.42	1073.46	1074.50	1075.54	1076.58	1077.62	1078.66	1079.70	1080.74	1081.77	5.50
5.60	1081.77	1082.81	1083.85	1084.88	1085.91	1086.95	1087.98	1089.01	1090.04	1091.07	1092.10	5.60
5.70	1092.10	1093.13	1094.16	1095.19	1096.21	1097.24	1098.27	1099.29	1100.32	1101.34	1102.36	5.70
5.80	1102.36	1103.38	1104.41	1105.43	1106.45	1107.47	1108.49	1109.50	1110.52	1111.54	1112.55	5.80
5.90	1112.55	1113.57	1114.59	1115.60	1116.61	1117.63	1118.64	1119.65	1120.66	1121.67	1122.68	5.90
6.00	1122.68	1123.69	1124.70	1125.71	1126.72	1127.72	1128.73	1129.74	1130.74	1131.75	1132.75	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A4.2.1. *Type B thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
6.00	1122.68	1123.69	1124.70	1125.71	1126.72	1127.72	1128.73	1129.74	1130.74	1131.75	1132.75	6.00
6.10	1132.75	1133.75	1134.76	1135.76	1136.76	1137.76	1138.76	1139.76	1140.76	1141.76	1142.76	6.10
6.20	1142.76	1143.75	1144.75	1145.75	1146.74	1147.74	1148.73	1149.72	1150.72	1151.71	1152.70	6.20
6.30	1152.70	1153.69	1154.69	1155.68	1156.67	1157.65	1158.64	1159.63	1160.62	1161.61	1162.59	6.30
6.40	1162.59	1163.58	1164.56	1165.55	1166.53	1167.52	1168.50	1169.48	1170.46	1171.45	1172.43	6.40
6.50	1172.43	1173.41	1174.39	1175.37	1176.35	1177.32	1178.30	1179.28	1180.26	1181.23	1182.21	6.50
6.60	1182.21	1183.18	1184.16	1185.13	1186.10	1187.08	1188.05	1189.02	1189.99	1190.96	1191.93	6.60
6.70	1191.93	1192.90	1193.87	1194.84	1195.81	1196.78	1197.75	1198.71	1199.68	1200.65	1201.61	6.70
6.80	1201.61	1202.58	1203.54	1204.51	1205.47	1206.43	1207.39	1208.36	1209.32	1210.28	1211.24	6.80
6.90	1211.24	1212.20	1213.16	1214.12	1215.08	1216.03	1216.99	1217.95	1218.91	1219.86	1220.82	6.90
7.00	1220.82	1221.77	1222.73	1223.68	1224.64	1225.59	1226.54	1227.50	1228.45	1229.40	1230.35	7.00
7.10	1230.35	1231.30	1232.25	1233.20	1234.15	1235.10	1236.05	1237.00	1237.95	1238.89	1239.84	7.10
7.20	1239.84	1240.79	1241.73	1242.68	1243.62	1244.57	1245.51	1246.45	1247.40	1248.34	1249.28	7.20
7.30	1249.28	1250.23	1251.17	1252.11	1253.05	1253.99	1254.93	1255.87	1256.81	1257.75	1258.68	7.30
7.40	1258.68	1259.62	1260.56	1261.50	1262.43	1263.37	1264.31	1265.24	1266.18	1267.11	1268.04	7.40
7.50	1268.04	1268.98	1269.91	1270.84	1271.78	1272.71	1273.64	1274.57	1275.50	1276.43	1277.36	7.50
7.60	1277.36	1278.29	1279.22	1280.15	1281.08	1282.01	1282.94	1283.86	1284.79	1285.72	1286.65	7.60
7.70	1286.65	1287.57	1288.50	1289.42	1290.35	1291.27	1292.20	1293.12	1294.04	1294.97	1295.89	7.70
7.80	1295.89	1296.81	1297.73	1298.65	1299.58	1300.50	1301.42	1302.34	1303.26	1304.18	1305.09	7.80
7.90	1305.09	1306.01	1306.93	1307.85	1308.77	1309.68	1310.60	1311.52	1312.43	1313.35	1314.27	7.90
8.00	1314.27	1315.18	1316.10	1317.01	1317.92	1318.84	1319.75	1320.67	1321.58	1322.49	1323.40	8.00
8.10	1323.40	1324.31	1325.23	1326.14	1327.05	1327.96	1328.87	1329.78	1330.69	1331.60	1332.51	8.10
8.20	1332.51	1333.41	1334.32	1335.23	1336.14	1337.05	1337.95	1338.86	1339.77	1340.67	1341.58	8.20
8.30	1341.58	1342.48	1343.39	1344.29	1345.20	1346.10	1347.01	1347.91	1348.81	1349.72	1350.62	8.30
8.40	1350.62	1351.52	1352.42	1353.32	1354.23	1355.13	1356.03	1356.93	1357.83	1358.73	1359.63	8.40
8.50	1359.63	1360.53	1361.43	1362.33	1363.22	1364.12	1365.02	1365.92	1366.82	1367.71	1368.61	8.50
8.60	1368.61	1369.51	1370.40	1371.30	1372.19	1373.09	1373.99	1374.88	1375.77	1376.67	1377.56	8.60
8.70	1377.56	1378.46	1379.35	1380.24	1381.14	1382.03	1382.92	1383.81	1384.71	1385.60	1386.49	8.70
8.80	1386.49	1387.38	1388.27	1389.16	1390.05	1390.94	1391.83	1392.72	1393.61	1394.50	1395.39	8.80
8.90	1395.39	1396.28	1397.17	1398.06	1398.94	1399.83	1400.72	1401.61	1402.49	1403.38	1404.27	8.90
9.00	1404.27	1405.15	1406.04	1406.92	1407.81	1408.69	1409.58	1410.46	1411.35	1412.23	1413.12	9.00
9.10	1413.12	1414.00	1414.88	1415.77	1416.65	1417.53	1418.42	1419.30	1420.18	1421.06	1421.95	9.10
9.20	1421.95	1422.83	1423.71	1424.59	1425.47	1426.35	1427.23	1428.11	1428.99	1429.87	1430.75	9.20
9.30	1430.75	1431.63	1432.51	1433.39	1434.27	1435.15	1436.02	1436.90	1437.78	1438.66	1439.54	9.30
9.40	1439.54	1440.41	1441.29	1442.17	1443.04	1443.92	1444.80	1445.67	1446.55	1447.43	1448.30	9.40
9.50	1448.30	1449.18	1450.05	1450.93	1451.80	1452.68	1453.55	1454.43	1455.30	1456.17	1457.05	9.50
9.60	1457.05	1457.92	1458.79	1459.67	1460.54	1461.41	1462.29	1463.16	1464.03	1464.90	1465.77	9.60
9.70	1465.77	1466.65	1467.52	1468.39	1469.26	1470.13	1471.00	1471.87	1472.74	1473.61	1474.48	9.70
9.80	1474.48	1475.35	1476.22	1477.09	1477.96	1478.83	1479.70	1480.57	1481.44	1482.31	1483.18	9.80
9.90	1483.18	1484.05	1484.91	1485.78	1486.65	1487.52	1488.38	1489.25	1490.12	1490.99	1491.85	9.90
10.00	1491.85	1492.72	1493.59	1494.45	1495.32	1496.19	1497.05	1497.92	1498.79	1499.65	1500.52	10.00
10.10	1500.52	1501.38	1502.25	1503.11	1503.98	1504.84	1505.71	1506.57	1507.44	1508.30	1509.17	10.10
10.20	1509.17	1510.03	1510.89	1511.76	1512.62	1513.49	1514.35	1515.21	1516.08	1516.94	1517.80	10.20
10.30	1517.80	1518.66	1519.53	1520.39	1521.25	1522.12	1522.98	1523.84	1524.70	1525.56	1526.43	10.30
10.40	1526.43	1527.29	1528.15	1529.01	1529.87	1530.73	1531.59	1532.46	1533.32	1534.18	1535.04	10.40
10.50	1535.04	1535.90	1536.76	1537.62	1538.48	1539.34	1540.20	1541.06	1541.92	1542.78	1543.64	10.50
10.60	1543.64	1544.50	1545.36	1546.22	1547.08	1547.94	1548.80	1549.66	1550.52	1551.38	1552.23	10.60
10.70	1552.23	1553.09	1553.95	1554.81	1555.67	1556.53	1557.39	1558.24	1559.10	1559.96	1560.82	10.70
10.80	1560.82	1561.68	1562.53	1563.39	1564.25	1565.11	1565.97	1566.82	1567.68	1568.54	1569.40	10.80
10.90	1569.40	1570.25	1571.11	1571.97	1572.82	1573.68	1574.54	1575.40	1576.25	1577.11	1577.97	10.90
11.00	1577.97	1578.82	1579.68	1580.54	1581.39	1582.25	1583.11	1583.96	1584.82	1585.67	1586.53	11.00
11.10	1586.53	1587.39	1588.24	1589.10	1589.95	1590.81	1591.67	1592.52	1593.38	1594.23	1595.09	11.10
11.20	1595.09	1595.95	1596.80	1597.66	1598.51	1599.37	1600.22	1601.08	1601.93	1602.79	1603.65	11.20
11.30	1603.65	1604.50	1605.36	1606.21	1607.07	1607.92	1608.78	1609.63	1610.49	1611.34	1612.20	11.30
11.40	1612.20	1613.05	1613.91	1614.76	1615.62	1616.47	1617.33	1618.18	1619.04	1619.89	1620.75	11.40
11.50	1620.75	1621.60	1622.46	1623.31	1624.17	1625.02	1625.88	1626.73	1627.59	1628.44	1629.30	11.50
11.60	1629.30	1630.15	1631.01	1631.86	1632.72	1633.57	1634.43	1635.28	1636.13	1636.99	1637.84	11.60
11.70	1637.84	1638.70	1639.55	1640.41	1641.26	1642.12	1642.97	1643.83	1644.68	1645.54	1646.39	11.70
11.80	1646.39	1647.25	1648.10	1648.96	1649.81	1650.67	1651.52	1652.38	1653.23	1654.09	1654.94	11.80
11.90	1654.94	1655.80	1656.65	1657.51	1658.36	1659.22	1660.07	1660.93	1661.78	1662.64	1663.49	11.90
12.00	1663.49	1664.35	1665.21	1666.06	1666.92	1667.77	1668.63	1669.48	1670.34	1671.19	1672.05	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A4.2.1. *Type B thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPITS 1968)												
12.00	1663.49	1664.35	1665.21	1666.06	1666.92	1667.77	1668.63	1669.48	1670.34	1671.19	1672.05	12.00
12.10	1672.05	1672.91	1673.76	1674.62	1675.47	1676.33	1677.18	1678.04	1678.90	1679.75	1680.61	12.10
12.20	1680.61	1681.46	1682.32	1683.18	1684.03	1684.89	1685.75	1686.60	1687.46	1688.32	1689.17	12.20
12.30	1689.17	1690.03	1690.89	1691.74	1692.60	1693.46	1694.31	1695.17	1696.03	1696.88	1697.74	12.30
12.40	1697.74	1698.60	1699.46	1700.31	1701.17	1702.03	1702.89	1703.74	1704.60	1705.46	1706.32	12.40
12.50	1706.32	1707.18	1708.03	1708.89	1709.75	1710.61	1711.47	1712.33	1713.18	1714.04	1714.90	12.50
12.60	1714.90	1715.76	1716.62	1717.48	1718.34	1719.20	1720.06	1720.92	1721.77	1722.63	1723.49	12.60
12.70	1723.49	1724.35	1725.21	1726.07	1726.93	1727.79	1728.65	1729.51	1730.37	1731.23	1732.10	12.70
12.80	1732.10	1732.96	1733.82	1734.68	1735.54	1736.40	1737.26	1738.12	1738.98	1739.85	1740.71	12.80
12.90	1740.71	1741.57	1742.43	1743.29	1744.15	1745.02	1745.88	1746.74	1747.60	1748.47	1749.33	12.90
13.00	1749.33	1750.19	1751.06	1751.92	1752.78	1753.65	1754.51	1755.37	1756.24	1757.10	1757.96	13.00
13.10	1757.96	1758.83	1759.69	1760.56	1761.42	1762.29	1763.15	1764.02	1764.88	1765.75	1766.61	13.10
13.20	1766.61	1767.48	1768.34	1769.21	1770.08	1770.94	1771.81	1772.67	1773.54	1774.41	1775.27	13.20
13.30	1775.27	1776.14	1777.01	1777.87	1778.74	1779.61	1780.48	1781.35	1782.21	1783.08	1783.95	13.30
13.40	1783.95	1784.82	1785.69	1786.56	1787.42	1788.29	1789.16	1790.03	1790.90	1791.77	1792.64	13.40
13.50	1792.64	1793.51	1794.38	1795.25	1796.12	1796.99	1797.86	1798.74	1799.61	1800.48	1801.35	13.50
13.60	1801.35	1802.22	1803.09	1803.97	1804.84	1805.71	1806.58	1807.46	1808.33	1809.20	1810.07	13.60
13.70	1810.07	1810.95	1811.82	1812.70	1813.57	1814.44	1815.32	1816.19	1817.07	1817.94	1818.82	13.70
13.80	1818.82	1819.69										13.80
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A4.2.2. *Type B thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
0.00	107.88	153.93	182.64	205.49	225.06	242.46	258.30	272.94	286.61	299.49	311.71	0.00
0.10	311.71	323.35	334.50	345.21	355.53	365.50	375.16	384.53	393.64	402.51	411.16	0.10
0.20	411.16	419.60	427.85	435.92	443.82	451.57	459.17	466.63	473.96	481.16	488.24	0.20
0.30	488.24	495.21	502.08	508.84	515.50	522.07	528.55	534.95	541.26	547.49	553.65	0.30
0.40	553.65	559.73	565.74	571.69	577.56	583.38	589.13	594.82	600.46	606.04	611.56	0.40
0.50	611.56	617.03	622.45	627.83	633.15	638.42	643.65	648.84	653.98	659.08	664.14	0.50
0.60	664.14	669.16	674.14	679.09	683.99	688.86	693.69	698.49	703.25	707.99	712.68	0.60
0.70	712.68	717.35	721.99	726.59	731.17	735.71	740.23	744.72	749.18	753.62	758.03	0.70
0.80	758.03	762.41	766.77	771.10	775.40	779.69	783.95	788.18	792.40	796.59	800.76	0.80
0.90	800.76	804.90	809.03	813.13	817.22	821.28	825.32	829.34	833.35	837.33	841.30	0.90
1.00	841.30	845.25	849.18	853.09	856.98	860.86	864.71	868.56	872.38	876.19	879.98	1.00
1.10	879.98	883.76	887.52	891.26	894.99	898.71	902.40	906.09	909.76	913.41	917.05	1.10
1.20	917.05	920.68	924.29	927.89	931.48	935.05	938.61	942.15	945.69	949.21	952.71	1.20
1.30	952.71	956.21	959.69	963.16	966.62	970.07	973.50	976.92	980.34	983.74	987.13	1.30
1.40	987.13	990.50	993.87	997.23	1000.57	1003.91	1007.23	1010.54	1013.85	1017.14	1020.42	1.40
1.50	1020.42	1023.70	1026.96	1030.21	1033.45	1036.69	1039.91	1043.13	1046.33	1049.53	1052.72	1.50
1.60	1052.72	1055.89	1059.06	1062.22	1065.37	1068.52	1071.65	1074.77	1077.89	1081.00	1084.10	1.60
1.70	1084.10	1087.19	1090.27	1093.35	1096.42	1099.48	1102.53	1105.57	1108.61	1111.64	1114.66	1.70
1.80	1114.66	1117.67	1120.67	1123.67	1126.66	1129.64	1132.62	1135.59	1138.55	1141.50	1144.45	1.80
1.90	1144.45	1147.39	1150.33	1153.25	1156.17	1159.09	1161.99	1164.89	1167.78	1170.67	1173.55	1.90
2.00	1173.55	1176.42	1179.29	1182.15	1185.01	1187.86	1190.70	1193.53	1196.36	1199.19	1202.00	2.00
2.10	1202.00	1204.82	1207.62	1210.42	1213.22	1216.00	1218.79	1221.56	1224.33	1227.10	1229.86	2.10
2.20	1229.86	1232.61	1235.36	1238.10	1240.84	1243.57	1246.30	1249.02	1251.74	1254.45	1257.16	2.20
2.30	1257.16	1259.86	1262.55	1265.24	1267.93	1270.61	1273.28	1275.95	1278.62	1281.28	1283.93	2.30
2.40	1283.93	1286.58	1289.23	1291.87	1294.51	1297.14	1299.76	1302.39	1305.00	1307.62	1310.22	2.40
2.50	1310.22	1312.83	1315.43	1318.02	1320.61	1323.20	1325.78	1328.35	1330.93	1333.49	1336.06	2.50
2.60	1336.06	1338.62	1341.17	1343.72	1346.27	1348.81	1351.35	1353.88	1356.41	1358.94	1361.46	2.60
2.70	1361.46	1363.98	1366.49	1369.00	1371.50	1374.01	1376.50	1379.00	1381.49	1383.97	1386.46	2.70
2.80	1386.46	1388.93	1391.41	1393.88	1396.35	1398.81	1401.27	1403.72	1406.18	1408.62	1411.07	2.80
2.90	1411.07	1413.51	1415.95	1418.38	1420.81	1423.24	1425.66	1428.08	1430.50	1432.91	1435.32	2.90
3.00	1435.32	1437.72	1440.13	1442.52	1444.92	1447.31	1449.70	1452.09	1454.47	1456.85	1459.22	3.00
3.10	1459.22	1461.59	1463.96	1466.33	1468.69	1471.05	1473.41	1475.76	1478.11	1480.46	1482.80	3.10
3.20	1482.80	1485.14	1487.48	1489.81	1492.14	1494.47	1496.79	1499.12	1501.44	1503.75	1506.06	3.20
3.30	1506.06	1508.37	1510.68	1512.99	1515.29	1517.58	1519.88	1522.17	1524.46	1526.75	1529.03	3.30
3.40	1529.03	1531.31	1533.59	1535.87	1538.14	1540.41	1542.68	1544.94	1547.20	1549.46	1551.72	3.40
3.50	1551.72	1553.97	1556.22	1558.47	1560.71	1562.96	1565.20	1567.43	1569.67	1571.90	1574.13	3.50
3.60	1574.13	1576.36	1578.58	1580.80	1583.02	1585.24	1587.45	1589.66	1591.87	1594.08	1596.28	3.60
3.70	1596.28	1598.49	1600.68	1602.88	1605.08	1607.27	1609.46	1611.64	1613.83	1616.01	1618.19	3.70
3.80	1618.19	1620.37	1622.54	1624.71	1626.88	1629.05	1631.22	1633.38	1635.54	1637.70	1639.86	3.80
3.90	1639.86	1642.01	1644.16	1646.31	1648.46	1650.60	1652.75	1654.89	1657.03	1659.16	1661.30	3.90
4.00	1661.30	1663.43	1665.56	1667.68	1669.81	1671.93	1674.05	1676.17	1678.29	1680.40	1682.51	4.00
4.10	1682.51	1684.62	1686.73	1688.84	1690.94	1693.04	1695.14	1697.24	1699.34	1701.43	1703.52	4.10
4.20	1703.52	1705.61	1707.70	1709.78	1711.87	1713.95	1716.03	1718.11	1720.18	1722.25	1724.33	4.20
4.30	1724.33	1726.40	1728.46	1730.53	1732.59	1734.65	1736.71	1738.77	1740.83	1742.88	1744.93	4.30
4.40	1744.93	1746.98	1749.03	1751.08	1753.12	1755.17	1757.21	1759.25	1761.28	1763.32	1765.35	4.40
4.50	1765.35	1767.39	1769.42	1771.44	1773.47	1775.49	1777.52	1779.54	1781.56	1783.58	1785.59	4.50
4.60	1785.59	1787.60	1789.62	1791.63	1793.64	1795.64	1797.65	1799.65	1801.65	1803.65	1805.65	4.60
4.70	1805.65	1807.65	1809.64	1811.64	1813.63	1815.62	1817.61	1819.59	1821.58	1823.56	1825.54	4.70
4.80	1825.54	1827.52	1829.50	1831.48	1833.45	1835.43	1837.40	1839.37	1841.34	1843.31	1845.27	4.80
4.90	1845.27	1847.23	1849.20	1851.16	1853.12	1855.07	1857.03	1858.99	1860.94	1862.89	1864.84	4.90
5.00	1864.84	1866.79	1868.73	1870.68	1872.62	1874.57	1876.51	1878.45	1880.38	1882.32	1884.25	5.00
5.10	1884.25	1886.19	1888.12	1890.05	1891.98	1893.91	1895.83	1897.76	1899.68	1901.60	1903.52	5.10
5.20	1903.52	1905.44	1907.36	1909.27	1911.19	1913.10	1915.01	1916.92	1918.83	1920.74	1922.64	5.20
5.30	1922.64	1924.55	1926.45	1928.35	1930.25	1932.15	1934.05	1935.95	1937.84	1939.74	1941.63	5.30
5.40	1941.63	1943.52	1945.41	1947.30	1949.18	1951.07	1952.95	1954.84	1956.72	1958.60	1960.48	5.40
5.50	1960.48	1962.35	1964.23	1966.10	1967.98	1969.85	1971.72	1973.59	1975.46	1977.33	1979.19	5.50
5.60	1979.19	1981.06	1982.92	1984.78	1986.64	1988.50	1990.36	1992.22	1994.08	1995.93	1997.78	5.60
5.70	1997.78	1999.64	2001.49	2003.34	2005.19	2007.03	2008.88	2010.72	2012.57	2014.41	2016.25	5.70
5.80	2016.25	2018.09	2019.93	2021.77	2023.60	2025.44	2027.27	2029.11	2030.94	2032.77	2034.60	5.80
5.90	2034.60	2036.43	2038.25	2040.08	2041.91	2043.73	2045.55	2047.37	2049.19	2051.01	2052.83	5.90
6.00	2052.83	2054.65	2056.46	2058.28	2060.09	2061.90	2063.72	2065.53	2067.34	2069.14	2070.95	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A4.2.2. *Type B thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
6.00	2052.83	2054.65	2056.46	2058.28	2060.09	2061.90	2063.72	2065.53	2067.34	2069.14	2070.95	6.00
6.10	2070.95	2072.76	2074.56	2076.36	2078.17	2079.97	2081.77	2083.57	2085.37	2087.16	2088.96	6.10
6.20	2088.96	2090.76	2092.55	2094.34	2096.14	2097.93	2099.72	2101.50	2103.29	2105.08	2106.87	6.20
6.30	2106.87	2108.65	2110.43	2112.22	2114.00	2115.78	2117.56	2119.34	2121.11	2122.89	2124.67	6.30
6.40	2124.67	2126.44	2128.21	2129.99	2131.76	2133.53	2135.30	2137.07	2138.84	2140.60	2142.37	6.40
6.50	2142.37	2144.13	2145.90	2147.66	2149.42	2151.18	2152.94	2154.70	2156.46	2158.22	2159.97	6.50
6.60	2159.97	2161.73	2163.48	2165.24	2166.99	2168.74	2170.49	2172.24	2173.99	2175.74	2177.48	6.60
6.70	2177.48	2179.23	2180.97	2182.72	2184.46	2186.20	2187.94	2189.68	2191.42	2193.16	2194.90	6.70
6.80	2194.90	2196.64	2198.37	2200.11	2201.84	2203.58	2205.31	2207.04	2208.77	2210.50	2212.23	6.80
6.90	2212.23	2213.96	2215.69	2217.41	2219.14	2220.86	2222.59	2224.31	2226.03	2227.75	2229.47	6.90
7.00	2229.47	2231.19	2232.91	2234.63	2236.35	2238.06	2239.78	2241.49	2243.21	2244.92	2246.63	7.00
7.10	2246.63	2248.34	2250.06	2251.77	2253.47	2255.18	2256.89	2258.60	2260.30	2262.01	2263.71	7.10
7.20	2263.71	2265.41	2267.12	2268.82	2270.52	2272.22	2273.92	2275.62	2277.32	2279.01	2280.71	7.20
7.30	2280.71	2282.41	2284.10	2285.79	2287.49	2289.18	2290.87	2292.56	2294.25	2295.94	2297.63	7.30
7.40	2297.63	2299.32	2301.01	2302.69	2304.38	2306.07	2307.75	2309.43	2311.12	2312.80	2314.48	7.40
7.50	2314.48	2316.16	2317.84	2319.52	2321.20	2322.88	2324.55	2326.23	2327.91	2329.58	2331.26	7.50
7.60	2331.26	2332.93	2334.60	2336.27	2337.95	2339.62	2341.29	2342.96	2344.63	2346.29	2347.96	7.60
7.70	2347.96	2349.63	2351.29	2352.96	2354.62	2356.29	2357.95	2359.61	2361.28	2362.94	2364.60	7.70
7.80	2364.60	2366.26	2367.92	2369.58	2371.24	2372.89	2374.55	2376.21	2377.86	2379.52	2381.17	7.80
7.90	2381.17	2382.82	2384.48	2386.13	2387.78	2389.43	2391.08	2392.73	2394.38	2396.03	2397.68	7.90
8.00	2397.68	2399.33	2400.97	2402.62	2404.26	2405.91	2407.55	2409.20	2410.84	2412.48	2414.13	8.00
8.10	2414.13	2415.77	2417.41	2419.05	2420.69	2422.33	2423.96	2425.60	2427.24	2428.88	2430.51	8.10
8.20	2430.51	2432.15	2433.78	2435.42	2437.05	2438.68	2440.32	2441.95	2443.58	2445.21	2446.84	8.20
8.30	2446.84	2448.47	2450.10	2451.73	2453.36	2454.98	2456.61	2458.24	2459.86	2461.49	2463.11	8.30
8.40	2463.11	2464.74	2466.36	2467.98	2469.61	2471.23	2472.85	2474.47	2476.09	2477.71	2479.33	8.40
8.50	2479.33	2480.95	2482.57	2484.19	2485.80	2487.42	2489.04	2490.65	2492.27	2493.88	2495.50	8.50
8.60	2495.50	2497.11	2498.72	2500.34	2501.95	2503.56	2505.17	2506.78	2508.39	2510.00	2511.61	8.60
8.70	2511.61	2513.22	2514.83	2516.44	2518.05	2519.65	2521.26	2522.87	2524.47	2526.08	2527.68	8.70
8.80	2527.68	2529.29	2530.89	2532.49	2534.10	2535.70	2537.30	2538.90	2540.50	2542.10	2543.70	8.80
8.90	2543.70	2545.30	2546.90	2548.50	2550.10	2551.70	2553.29	2554.89	2556.49	2558.08	2559.68	8.90
9.00	2559.68	2561.27	2562.87	2564.46	2566.06	2567.65	2569.24	2570.83	2572.43	2574.02	2575.61	9.00
9.10	2575.61	2577.20	2578.79	2580.38	2581.97	2583.56	2585.15	2586.74	2588.33	2589.91	2591.50	9.10
9.20	2591.50	2593.09	2594.67	2596.26	2597.85	2599.43	2601.02	2602.60	2604.19	2605.77	2607.35	9.20
9.30	2607.35	2608.94	2610.52	2612.10	2613.68	2615.26	2616.84	2618.43	2620.01	2621.59	2623.17	9.30
9.40	2623.17	2624.74	2626.32	2627.90	2629.48	2631.06	2632.64	2634.21	2635.79	2637.37	2638.94	9.40
9.50	2638.94	2640.52	2642.09	2643.67	2645.24	2646.82	2648.39	2649.97	2651.54	2653.11	2654.68	9.50
9.60	2654.68	2656.26	2657.83	2659.40	2660.97	2662.54	2664.11	2665.68	2667.25	2668.82	2670.39	9.60
9.70	2670.39	2671.96	2673.53	2675.10	2676.67	2678.24	2679.80	2681.37	2682.94	2684.50	2686.07	9.70
9.80	2686.07	2687.64	2689.20	2690.77	2692.33	2693.90	2695.46	2697.03	2698.59	2700.15	2701.72	9.80
9.90	2701.72	2703.28	2704.84	2706.41	2707.97	2709.53	2711.09	2712.65	2714.22	2715.78	2717.34	9.90
10.00	2717.34	2718.90	2720.46	2722.02	2723.58	2725.14	2726.70	2728.26	2729.81	2731.37	2732.93	10.00
10.10	2732.93	2734.49	2736.05	2737.60	2739.16	2740.72	2742.27	2743.83	2745.39	2746.94	2748.50	10.10
10.20	2748.50	2750.05	2751.61	2753.16	2754.72	2756.27	2757.83	2759.38	2760.94	2762.49	2764.04	10.20
10.30	2764.04	2765.60	2767.15	2768.70	2770.25	2771.81	2773.36	2774.91	2776.46	2778.01	2779.57	10.30
10.40	2779.57	2781.12	2782.67	2784.22	2785.77	2787.32	2788.87	2790.42	2791.97	2793.52	2795.07	10.40
10.50	2795.07	2796.62	2798.17	2799.72	2801.27	2802.81	2804.36	2805.91	2807.46	2809.01	2810.55	10.50
10.60	2810.55	2812.10	2813.65	2815.20	2816.74	2818.29	2819.84	2821.38	2822.93	2824.48	2826.02	10.60
10.70	2826.02	2827.57	2829.11	2830.66	2832.20	2833.75	2835.29	2836.84	2838.38	2839.93	2841.47	10.70
10.80	2841.47	2843.02	2844.56	2846.11	2847.65	2849.19	2850.74	2852.28	2853.83	2855.37	2856.91	10.80
10.90	2856.91	2858.46	2860.00	2861.54	2863.08	2864.63	2866.17	2867.71	2869.25	2870.80	2872.34	10.90
11.00	2872.34	2873.88	2875.42	2876.96	2878.51	2880.05	2881.59	2883.13	2884.67	2886.21	2887.75	11.00
11.10	2887.75	2889.30	2890.84	2892.38	2893.92	2895.46	2897.00	2898.54	2900.08	2901.62	2903.16	11.10
11.20	2903.16	2904.70	2906.24	2907.78	2909.32	2910.86	2912.40	2913.94	2915.48	2917.02	2918.56	11.20
11.30	2918.56	2920.10	2921.64	2923.18	2924.72	2926.26	2927.80	2929.34	2930.88	2932.42	2933.96	11.30
11.40	2933.96	2935.50	2937.03	2938.57	2940.11	2941.65	2943.19	2944.73	2946.27	2947.81	2949.35	11.40
11.50	2949.35	2950.88	2952.42	2953.96	2955.50	2957.04	2958.58	2960.12	2961.66	2963.19	2964.73	11.50
11.60	2964.73	2966.27	2967.81	2969.35	2970.89	2972.43	2973.97	2975.50	2977.04	2978.58	2980.12	11.60
11.70	2980.12	2981.66	2983.20	2984.74	2986.27	2987.81	2989.35	2990.89	2992.43	2993.97	2995.51	11.70
11.80	2995.51	2997.05	2998.58	3000.12	3001.66	3003.20	3004.74	3006.28	3007.82	3009.36	3010.90	11.80
11.90	3010.90	3012.44	3013.98	3015.51	3017.05	3018.59	3020.13	3021.67	3023.21	3024.75	3026.29	11.90
12.00	3026.29	3027.83	3029.37	3030.91	3032.45	3033.99	3035.53	3037.07	3038.61	3040.15	3041.69	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A4.2.2. *Type B thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
12.00	3026.29	3027.83	3029.37	3030.91	3032.45	3033.99	3035.53	3037.07	3038.61	3040.15	3041.69	12.00
12.10	3041.69	3043.23	3044.77	3046.31	3047.85	3049.39	3050.93	3052.47	3054.01	3055.55	3057.10	12.10
12.20	3057.10	3058.64	3060.18	3061.72	3063.26	3064.80	3066.34	3067.88	3069.43	3070.97	3072.51	12.20
12.30	3072.51	3074.05	3075.59	3077.14	3078.68	3080.22	3081.76	3083.31	3084.85	3086.39	3087.94	12.30
12.40	3087.94	3089.48	3091.02	3092.56	3094.11	3095.65	3097.20	3098.74	3100.28	3101.83	3103.37	12.40
12.50	3103.37	3104.92	3106.46	3108.01	3109.55	3111.10	3112.64	3114.19	3115.73	3117.28	3118.82	12.50
12.60	3118.82	3120.37	3121.91	3123.46	3125.01	3126.55	3128.10	3129.65	3131.19	3132.74	3134.29	12.60
12.70	3134.29	3135.84	3137.38	3138.93	3140.48	3142.03	3143.58	3145.12	3146.67	3148.22	3149.77	12.70
12.80	3149.77	3151.32	3152.87	3154.42	3155.97	3157.52	3159.07	3160.62	3162.17	3163.72	3165.27	12.80
12.90	3165.27	3166.82	3168.37	3169.93	3171.48	3173.03	3174.58	3176.13	3177.69	3179.24	3180.79	12.90
13.00	3180.79	3182.35	3183.90	3185.45	3187.01	3188.56	3190.12	3191.67	3193.23	3194.78	3196.34	13.00
13.10	3196.34	3197.89	3199.45	3201.00	3202.56	3204.12	3205.67	3207.23	3208.79	3210.34	3211.90	13.10
13.20	3211.90	3213.46	3215.02	3216.58	3218.14	3219.69	3221.25	3222.81	3224.37	3225.93	3227.49	13.20
13.30	3227.49	3229.05	3230.61	3232.17	3233.74	3235.30	3236.86	3238.42	3239.98	3241.55	3243.11	13.30
13.40	3243.11	3244.67	3246.24	3247.80	3249.36	3250.93	3252.49	3254.06	3255.62	3257.19	3258.75	13.40
13.50	3258.75	3260.32	3261.89	3263.45	3265.02	3266.59	3268.16	3269.72	3271.29	3272.86	3274.43	13.50
13.60	3274.43	3276.00	3277.57	3279.14	3280.71	3282.28	3283.85	3285.42	3286.99	3288.56	3290.13	13.60
13.70	3290.13	3291.71	3293.28	3294.85	3296.43	3298.00	3299.57	3301.15	3302.72	3304.30	3305.87	13.70
13.80	3305.87	3307.45										13.80

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
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TABLE A4.2.3. *Type B thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges (°C). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius*

Temperature Range (°C)	a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (°C)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
0 - 900	.....		8.9244743	-1	-5.7447033	-4	1.8053618	-7	-1.9719121	-11	-30 to 75
0 - 1100	.....		7.2874066	-1	-3.1771931	-4	6.8254996	-8	-5.1002233	-12	-35 to 90
0 - 1400	.....		5.7822214	-1	-1.6039309	-4	2.2187592	-8	-1.0678514	-12	-45 to 110
0 - 1650	.....		4.9929130	-1	-1.0349686	-4	1.0792281	-8	-3.9111456	-13	-50 to 120
0 - 1820	.....		4.6255054	-1	-8.2176262	-5	7.3717195	-9	-2.2913665	-13	-50 to 130
400 - 1100	1.8946288	+2	3.0966136	-1	-5.8100680	-5	8.2483967	-9	-4.7591774	-13	-09 to 1.0
400 - 1400	2.0949015	+2	2.7222162	-1	-3.6930932	-5	3.6830239	-9	-1.4483702	-13	-3 to 3
400 - 1650	2.2354664	+2	2.4988761	-1	-2.7160312	-5	2.1299660	-9	-6.4220755	-14	-5 to 5
1050 - 1400	3.2188156	+2	1.8282378	-1	-1.1561743	-5	6.4320083	-10	-1.4544375	-14	-.003 to .003
1050 - 1650	3.4418084	+2	1.7031473	-1	-8.9696912	-6	4.0789445	-10	-6.6410259	-15	-.025 to .020
1400 - 1550	3.7140306	+2	1.5828913	-1	-7.0050689	-6	2.6714849	-10	-2.9082072	-15	-.001 to .001
1400 - 1650	3.9253848	+2	1.4979551	-1	-5.7276293	-6	1.8192801	-10	-7.8042686	-16	-.001 to .001
II. Cubic Equation											
0 - 900	.....		6.8242988	-1	-2.4242314	-4	3.2592219	-8	.....		-40 to 90
0 - 1100	.....		5.5918644	-1	-1.3439422	-4	1.2359253	-8	.....		-45 to 110
0 - 1400	.....		4.4541819	-1	-6.7987267	-5	4.0352729	-9	.....		-55 to 130
0 - 1650	.....		3.8585853	-1	-4.4040462	-5	1.9839274	-9	.....		-65 to 150
0 - 1820	.....		3.5829683	-1	-3.5181242	-5	1.3793892	-9	.....		-65 to 150
400 - 1100	2.1366324	+2	2.6366866	-1	-3.0970222	-5	2.0662699	-9	.....		-3 to 3
400 - 1400	2.3652324	+2	2.3102266	-1	-1.9281120	-5	8.9765583	-10	.....		-7 to 7
400 - 1650	2.5209301	+2	2.1223567	-1	-1.4188409	-5	5.2948507	-10	.....		-11 to 11
1050 - 1400	3.5670679	+2	1.6256309	-1	-7.1928422	-6	2.2926761	-10	.....		-.04 to .03
1050 - 1650	3.7466984	+2	1.5488865	-1	-6.1233244	-6	1.8058506	-10	.....		-.11 to .12
1400 - 1550	3.9817575	+2	1.4733527	-1	-5.3265821	-6	1.5298380	-10	.....		-.001 to .001
1400 - 1650	4.0147206	+2	1.4632380	-1	-5.2233585	-6	1.4948027	-10	.....		-.001 to .001
III. Quadratic Equation											
0 - 900	.....		4.7270957	-1	-6.5220341	-5	.....		.....		-65 to 120
0 - 1100	.....		3.8926013	-1	-3.6220093	-5	.....		.....		-80 to 140
0 - 1400	.....		3.1163728	-1	-1.8256008	-5	.....		.....		-90 to 180
0 - 1650	.....		2.7022999	-1	-1.1654579	-5	.....		.....		-110 to 200
0 - 1820	.....		2.5245307	-1	-9.4061260	-6	.....		.....		-110 to 210
400 - 1100	2.5355729	+2	2.0807395	-1	-1.0857673	-5	.....		.....		-11 to 9
400 - 1400	2.8303829	+2	1.8022330	-1	-6.3505543	-6	.....		.....		-21 to 17
400 - 1650	3.0512133	+2	1.6307784	-1	-4.3127773	-6	.....		.....		-31 to 25
1050 - 1400	4.3473833	+2	1.2847162	-1	-2.3110713	-6	.....		.....		-.4 to .4
1050 - 1650	4.7551898	+2	1.1666506	-1	-1.4878794	-6	.....		.....		-2 to 2
1400 - 1550	5.4184661	+2	1.0323980	-1	-8.2376100	-7	.....		.....		-.03 to .03
1400 - 1650	5.6665626	+2	9.8158446	-2	-5.6467600	-7	.....		.....		-.12 to .13

A5. Supplementary Data for Type E—Nickel—Chromium Alloy Versus Copper—Nickel Alloy Thermocouples

A5.1. Data for Voltage as a Function of Temperature

The full precision coefficients given in the main text are used to generate the voltage as a function of temperature data given in tables A5.1.1 and A5.1.2. Table A5.1.1 presents the data in degrees Celsius from -270°C to 1000°C while table A5.1.2 presents the data in degrees Fahrenheit from -454°F to 1832°F . Table A5.1.3 contains quadratic, cubic, and quartic approximations to the data as a function of temperature in selected temperature ranges. The error range given in the table is the difference between the voltage as obtained from the full precision coefficients from the text and the respective reduced order approximations. The last entries in the cubic and quadratic groupings of table A5.1.3 represent variable reference junction corrections in the 0 to 50°C temperature range.

TABLE A5.1.1. *Type E thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C*

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-270	-9.835											-270
-260	-9.797	-9.802	-9.808	-9.813	-9.817	-9.821	-9.825	-9.828	-9.831	-9.833	-9.835	-260
-250	-9.719	-9.728	-9.737	-9.746	-9.754	-9.762	-9.770	-9.777	-9.784	-9.791	-9.797	-250
-240	-9.604	-9.617	-9.630	-9.642	-9.654	-9.666	-9.677	-9.688	-9.699	-9.709	-9.719	-240
-230	-9.455	-9.472	-9.488	-9.503	-9.519	-9.534	-9.549	-9.563	-9.577	-9.591	-9.604	-230
-220	-9.274	-9.293	-9.313	-9.332	-9.350	-9.368	-9.386	-9.404	-9.421	-9.438	-9.455	-220
-210	-9.063	-9.085	-9.107	-9.129	-9.151	-9.172	-9.193	-9.214	-9.234	-9.254	-9.274	-210
-200	-8.824	-8.850	-8.874	-8.899	-8.923	-8.947	-8.971	-8.994	-9.017	-9.040	-9.063	-200
-190	-8.561	-8.588	-8.615	-8.642	-8.669	-8.696	-8.722	-8.748	-8.774	-8.799	-8.824	-190
-180	-8.273	-8.303	-8.333	-8.362	-8.391	-8.420	-8.449	-8.477	-8.505	-8.533	-8.561	-180
-170	-7.963	-7.995	-8.027	-8.058	-8.090	-8.121	-8.152	-8.183	-8.213	-8.243	-8.273	-170
-160	-7.631	-7.665	-7.699	-7.733	-7.767	-7.800	-7.833	-7.866	-7.898	-7.931	-7.963	-160
-150	-7.279	-7.315	-7.351	-7.387	-7.422	-7.458	-7.493	-7.528	-7.562	-7.597	-7.631	-150
-140	-6.907	-6.945	-6.983	-7.020	-7.058	-7.095	-7.132	-7.169	-7.206	-7.243	-7.279	-140
-130	-6.516	-6.556	-6.596	-6.635	-6.675	-6.714	-6.753	-6.792	-6.830	-6.869	-6.907	-130
-120	-6.107	-6.149	-6.190	-6.231	-6.273	-6.314	-6.354	-6.395	-6.436	-6.476	-6.516	-120
-110	-5.680	-5.724	-5.767	-5.810	-5.853	-5.896	-5.938	-5.981	-6.023	-6.065	-6.107	-110
-100	-5.237	-5.282	-5.327	-5.371	-5.416	-5.460	-5.505	-5.549	-5.593	-5.637	-5.680	-100
-90	-4.777	-4.824	-4.870	-4.916	-4.963	-5.009	-5.055	-5.100	-5.146	-5.191	-5.237	-90
-80	-4.301	-4.350	-4.398	-4.446	-4.493	-4.541	-4.588	-4.636	-4.683	-4.730	-4.777	-80
-70	-3.811	-3.860	-3.910	-3.959	-4.009	-4.058	-4.107	-4.156	-4.204	-4.253	-4.301	-70
-60	-3.306	-3.357	-3.408	-3.459	-3.509	-3.560	-3.610	-3.661	-3.711	-3.761	-3.811	-60
-50	-2.787	-2.839	-2.892	-2.944	-2.996	-3.048	-3.100	-3.152	-3.203	-3.254	-3.306	-50
-40	-2.254	-2.308	-2.362	-2.416	-2.469	-2.522	-2.575	-2.628	-2.681	-2.734	-2.787	-40
-30	-1.709	-1.764	-1.819	-1.874	-1.929	-1.983	-2.038	-2.092	-2.146	-2.200	-2.254	-30
-20	-1.151	-1.208	-1.264	-1.320	-1.376	-1.432	-1.487	-1.543	-1.599	-1.654	-1.709	-20
-10	-0.581	-0.639	-0.696	-0.754	-0.811	-0.868	-0.925	-0.982	-1.038	-1.095	-1.151	-10
- 0	0.000	-0.059	-0.117	-0.176	-0.234	-0.292	-0.350	-0.408	-0.466	-0.524	-0.581	- 0
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A5.1.1. *Type E thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C—Continued*

°C	0	1	2	3	4	5	6	7	8	9	10	°C
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	0.000	0.059	0.118	0.176	0.235	0.295	0.354	0.413	0.472	0.532	0.591	0
10	0.591	0.651	0.711	0.770	0.830	0.890	0.950	1.011	1.071	1.131	1.192	10
20	1.192	1.252	1.313	1.373	1.434	1.495	1.556	1.617	1.678	1.739	1.801	20
30	1.801	1.862	1.924	1.985	2.047	2.109	2.171	2.233	2.295	2.357	2.419	30
40	2.419	2.482	2.544	2.607	2.669	2.732	2.795	2.858	2.921	2.984	3.047	40
50	3.047	3.110	3.173	3.237	3.300	3.364	3.428	3.491	3.555	3.619	3.683	50
60	3.683	3.748	3.812	3.876	3.941	4.005	4.070	4.134	4.199	4.264	4.329	60
70	4.329	4.394	4.459	4.524	4.590	4.655	4.720	4.786	4.852	4.917	4.983	70
80	4.983	5.049	5.115	5.181	5.247	5.314	5.380	5.446	5.513	5.579	5.646	80
90	5.646	5.713	5.780	5.846	5.913	5.981	6.048	6.115	6.182	6.250	6.317	90
100	6.317	6.385	6.452	6.520	6.588	6.656	6.724	6.792	6.860	6.928	6.996	100
110	6.996	7.064	7.133	7.201	7.270	7.339	7.407	7.476	7.545	7.614	7.683	110
120	7.683	7.752	7.821	7.890	7.960	8.029	8.099	8.168	8.238	8.307	8.377	120
130	8.377	8.447	8.517	8.587	8.657	8.727	8.797	8.867	8.938	9.008	9.078	130
140	9.078	9.149	9.220	9.290	9.361	9.432	9.503	9.573	9.644	9.715	9.787	140
150	9.787	9.858	9.929	10.000	10.072	10.143	10.215	10.286	10.358	10.429	10.501	150
160	10.501	10.573	10.645	10.717	10.789	10.861	10.933	11.005	11.077	11.150	11.222	160
170	11.222	11.294	11.367	11.439	11.512	11.585	11.657	11.730	11.803	11.876	11.949	170
180	11.949	12.022	12.095	12.168	12.241	12.314	12.387	12.461	12.534	12.608	12.681	180
190	12.681	12.755	12.828	12.902	12.975	13.049	13.123	13.197	13.271	13.345	13.419	190
200	13.419	13.493	13.567	13.641	13.715	13.789	13.864	13.938	14.012	14.087	14.161	200
210	14.161	14.236	14.310	14.385	14.460	14.534	14.609	14.684	14.759	14.834	14.909	210
220	14.909	14.984	15.059	15.134	15.209	15.284	15.359	15.435	15.510	15.585	15.661	220
230	15.661	15.736	15.812	15.887	15.963	16.038	16.114	16.190	16.266	16.341	16.417	230
240	16.417	16.493	16.569	16.645	16.721	16.797	16.873	16.949	17.025	17.101	17.178	240
250	17.178	17.254	17.330	17.406	17.483	17.559	17.636	17.712	17.789	17.865	17.942	250
260	17.942	18.018	18.095	18.172	18.248	18.325	18.402	18.479	18.556	18.633	18.710	260
270	18.710	18.787	18.864	18.941	19.018	19.095	19.172	19.249	19.326	19.404	19.481	270
280	19.481	19.558	19.636	19.713	19.790	19.868	19.945	20.023	20.100	20.178	20.256	280
290	20.256	20.333	20.411	20.488	20.566	20.644	20.722	20.800	20.877	20.955	21.033	290
300	21.033	21.111	21.189	21.267	21.345	21.423	21.501	21.579	21.657	21.735	21.814	300
310	21.814	21.892	21.970	22.048	22.127	22.205	22.283	22.362	22.440	22.518	22.597	310
320	22.597	22.675	22.754	22.832	22.911	22.989	23.068	23.147	23.225	23.304	23.383	320
330	23.383	23.461	23.540	23.619	23.698	23.777	23.855	23.934	24.013	24.092	24.171	330
340	24.171	24.250	24.329	24.408	24.487	24.566	24.645	24.724	24.803	24.882	24.961	340
350	24.961	25.041	25.120	25.199	25.278	25.357	25.437	25.516	25.595	25.675	25.754	350
360	25.754	25.833	25.913	25.992	26.072	26.151	26.230	26.310	26.389	26.469	26.549	360
370	26.549	26.628	26.708	26.787	26.867	26.947	27.026	27.106	27.186	27.265	27.345	370
380	27.345	27.425	27.504	27.584	27.664	27.744	27.824	27.903	27.983	28.063	28.143	380
390	28.143	28.223	28.303	28.383	28.463	28.543	28.623	28.703	28.783	28.863	28.943	390
400	28.943	29.023	29.103	29.183	29.263	29.343	29.423	29.503	29.584	29.664	29.744	400
410	29.744	29.824	29.904	29.984	30.065	30.145	30.225	30.305	30.386	30.466	30.546	410
420	30.546	30.627	30.707	30.787	30.868	30.948	31.028	31.109	31.189	31.270	31.350	420
430	31.350	31.430	31.511	31.591	31.672	31.752	31.833	31.913	31.994	32.074	32.155	430
440	32.155	32.235	32.316	32.396	32.477	32.557	32.638	32.719	32.799	32.880	32.960	440
450	32.960	33.041	33.122	33.202	33.283	33.364	33.444	33.525	33.605	33.686	33.767	450
460	33.767	33.848	33.928	34.009	34.090	34.170	34.251	34.332	34.413	34.493	34.574	460
470	34.574	34.655	34.736	34.816	34.897	34.978	35.059	35.140	35.220	35.301	35.382	470
480	35.382	35.463	35.544	35.624	35.705	35.786	35.867	35.948	36.029	36.109	36.190	480
490	36.190	36.271	36.352	36.433	36.514	36.595	36.675	36.756	36.837	36.918	36.999	490
500	36.999	37.080	37.161	37.242	37.323	37.403	37.484	37.565	37.646	37.727	37.808	500
510	37.808	37.889	37.970	38.051	38.132	38.213	38.293	38.374	38.455	38.536	38.617	510
520	38.617	38.698	38.779	38.860	38.941	39.022	39.103	39.184	39.264	39.345	39.426	520
530	39.426	39.507	39.588	39.669	39.750	39.831	39.912	39.993	40.074	40.155	40.236	530
540	40.236	40.316	40.397	40.478	40.559	40.640	40.721	40.802	40.883	40.964	41.045	540
550	41.045	41.125	41.206	41.287	41.368	41.449	41.530	41.611	41.692	41.773	41.853	550
560	41.853	41.934	42.015	42.096	42.177	42.258	42.339	42.419	42.500	42.581	42.662	560
570	42.662	42.743	42.824	42.904	42.985	43.066	43.147	43.228	43.308	43.389	43.470	570
580	43.470	43.551	43.632	43.712	43.793	43.874	43.955	44.035	44.116	44.197	44.278	580
590	44.278	44.358	44.439	44.520	44.601	44.681	44.762	44.843	44.923	45.004	45.085	590
600	45.085	45.165	45.246	45.327	45.407	45.488	45.569	45.649	45.730	45.811	45.891	600
°C	0	1	2	3	4	5	6	7	8	9	10	°C

TABLE A5.1.1. *Type E thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C—Continued*

°C	0	1	2	3	4	5	6	7	8	9	10	°C
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	45.085	45.165	45.246	45.327	45.407	45.488	45.569	45.649	45.730	45.811	45.891	600
610	45.891	45.972	46.052	46.133	46.213	46.294	46.375	46.455	46.536	46.616	46.697	610
620	46.697	46.777	46.858	46.938	47.019	47.099	47.180	47.260	47.341	47.421	47.502	620
630	47.502	47.582	47.663	47.743	47.824	47.904	47.984	48.065	48.145	48.226	48.306	630
640	48.306	48.386	48.467	48.547	48.627	48.708	48.788	48.868	48.949	49.029	49.109	640
650	49.109	49.189	49.270	49.350	49.430	49.510	49.591	49.671	49.751	49.831	49.911	650
660	49.911	49.992	50.072	50.152	50.232	50.312	50.392	50.472	50.553	50.633	50.713	660
670	50.713	50.793	50.873	50.953	51.033	51.113	51.193	51.273	51.353	51.433	51.513	670
680	51.513	51.593	51.673	51.753	51.833	51.913	51.993	52.073	52.152	52.232	52.312	680
690	52.312	52.392	52.472	52.552	52.632	52.711	52.791	52.871	52.951	53.031	53.110	690
700	53.110	53.190	53.270	53.350	53.429	53.509	53.589	53.668	53.748	53.828	53.907	700
710	53.907	53.987	54.066	54.146	54.226	54.305	54.385	54.464	54.544	54.623	54.703	710
720	54.703	54.782	54.862	54.941	55.021	55.100	55.180	55.259	55.339	55.418	55.498	720
730	55.498	55.577	55.656	55.736	55.815	55.894	55.974	56.053	56.132	56.212	56.291	730
740	56.291	56.370	56.449	56.529	56.608	56.687	56.766	56.845	56.924	57.004	57.083	740
750	57.083	57.162	57.241	57.320	57.399	57.478	57.557	57.636	57.715	57.794	57.873	750
760	57.873	57.952	58.031	58.110	58.189	58.268	58.347	58.426	58.505	58.584	58.663	760
770	58.663	58.742	58.820	58.899	58.978	59.057	59.136	59.214	59.293	59.372	59.451	770
780	59.451	59.529	59.608	59.687	59.765	59.844	59.923	60.001	60.080	60.159	60.237	780
790	60.237	60.316	60.394	60.473	60.551	60.630	60.708	60.787	60.865	60.944	61.022	790
800	61.022	61.101	61.179	61.258	61.336	61.414	61.493	61.571	61.649	61.728	61.806	800
810	61.806	61.884	61.962	62.041	62.119	62.197	62.275	62.353	62.432	62.510	62.588	810
820	62.588	62.666	62.744	62.822	62.900	62.978	63.056	63.134	63.212	63.290	63.368	820
830	63.368	63.446	63.524	63.602	63.680	63.758	63.836	63.914	63.992	64.069	64.147	830
840	64.147	64.225	64.303	64.380	64.458	64.536	64.614	64.691	64.769	64.847	64.924	840
850	64.924	65.002	65.080	65.157	65.235	65.312	65.390	65.467	65.545	65.622	65.700	850
860	65.700	65.777	65.855	65.932	66.009	66.087	66.164	66.241	66.319	66.396	66.473	860
870	66.473	66.551	66.628	66.705	66.782	66.859	66.937	67.014	67.091	67.168	67.245	870
880	67.245	67.322	67.399	67.476	67.553	67.630	67.707	67.784	67.861	67.938	68.015	880
890	68.015	68.092	68.169	68.246	68.323	68.399	68.476	68.553	68.630	68.706	68.783	890
900	68.783	68.860	68.936	69.013	69.090	69.166	69.243	69.320	69.396	69.473	69.549	900
910	69.549	69.626	69.702	69.779	69.855	69.931	70.008	70.084	70.161	70.237	70.313	910
920	70.313	70.390	70.466	70.542	70.618	70.694	70.771	70.847	70.923	70.999	71.075	920
930	71.075	71.151	71.227	71.304	71.380	71.456	71.532	71.608	71.683	71.759	71.835	930
940	71.835	71.911	71.987	72.063	72.139	72.215	72.290	72.366	72.442	72.518	72.593	940
950	72.593	72.669	72.745	72.820	72.896	72.972	73.047	73.123	73.199	73.274	73.350	950
960	73.350	73.425	73.501	73.576	73.652	73.727	73.802	73.878	73.953	74.029	74.104	960
970	74.104	74.179	74.255	74.330	74.405	74.480	74.556	74.631	74.706	74.781	74.857	970
980	74.857	74.932	75.007	75.082	75.157	75.232	75.307	75.382	75.458	75.533	75.608	980
990	75.608	75.683	75.758	75.833	75.908	75.983	76.058	76.133	76.208	76.283	76.358	990
1,000	76.358											1,000
°C	0	1	2	3	4	5	6	7	8	9	10	°C

TABLE A5.1.2. Type E thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F

$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-450	-9.830	-9.832	-9.833	-9.834	-9.835							-450
-440	-9.809	-9.812	-9.814	-9.817	-9.819	-9.821	-9.823	-9.825	-9.827	-9.829	-9.830	-440
-430	-9.775	-9.779	-9.783	-9.786	-9.790	-9.793	-9.797	-9.800	-9.803	-9.806	-9.809	-430
-420	-9.729	-9.734	-9.739	-9.744	-9.749	-9.753	-9.758	-9.762	-9.767	-9.771	-9.775	-420
-410	-9.672	-9.678	-9.684	-9.690	-9.696	-9.702	-9.708	-9.713	-9.719	-9.724	-9.729	-410
-400	-9.604	-9.611	-9.619	-9.626	-9.633	-9.639	-9.646	-9.653	-9.659	-9.666	-9.672	-400
-390	-9.526	-9.534	-9.542	-9.550	-9.558	-9.566	-9.574	-9.582	-9.589	-9.597	-9.604	-390
-380	-9.437	-9.446	-9.455	-9.464	-9.473	-9.482	-9.491	-9.500	-9.509	-9.517	-9.526	-380
-370	-9.338	-9.348	-9.358	-9.368	-9.378	-9.388	-9.398	-9.408	-9.418	-9.427	-9.437	-370
-360	-9.229	-9.241	-9.252	-9.263	-9.274	-9.285	-9.296	-9.306	-9.317	-9.327	-9.338	-360
-350	-9.112	-9.124	-9.136	-9.148	-9.160	-9.172	-9.184	-9.195	-9.207	-9.218	-9.229	-350
-340	-8.986	-8.999	-9.012	-9.025	-9.038	-9.050	-9.063	-9.075	-9.088	-9.100	-9.112	-340
-330	-8.852	-8.866	-8.880	-8.893	-8.907	-8.920	-8.934	-8.947	-8.960	-8.973	-8.986	-330
-320	-8.710	-8.725	-8.739	-8.754	-8.768	-8.782	-8.796	-8.810	-8.824	-8.838	-8.852	-320
-310	-8.561	-8.576	-8.591	-8.606	-8.621	-8.636	-8.651	-8.666	-8.681	-8.696	-8.710	-310
-300	-8.404	-8.420	-8.436	-8.452	-8.468	-8.483	-8.499	-8.514	-8.530	-8.545	-8.561	-300
-290	-8.240	-8.257	-8.273	-8.290	-8.306	-8.323	-8.339	-8.355	-8.372	-8.388	-8.404	-290
-280	-8.069	-8.086	-8.104	-8.121	-8.138	-8.155	-8.172	-8.189	-8.206	-8.223	-8.240	-280
-270	-7.891	-7.909	-7.927	-7.945	-7.963	-7.981	-7.999	-8.016	-8.034	-8.051	-8.069	-270
-260	-7.707	-7.726	-7.744	-7.763	-7.781	-7.800	-7.818	-7.837	-7.855	-7.873	-7.891	-260
-250	-7.516	-7.535	-7.555	-7.574	-7.593	-7.612	-7.631	-7.650	-7.669	-7.688	-7.707	-250
-240	-7.319	-7.339	-7.359	-7.379	-7.399	-7.418	-7.438	-7.458	-7.477	-7.497	-7.516	-240
-230	-7.116	-7.137	-7.157	-7.178	-7.198	-7.218	-7.239	-7.259	-7.279	-7.299	-7.319	-230
-220	-6.907	-6.928	-6.949	-6.970	-6.991	-7.012	-7.033	-7.054	-7.075	-7.095	-7.116	-220
-210	-6.692	-6.714	-6.735	-6.757	-6.779	-6.800	-6.822	-6.843	-6.864	-6.886	-6.907	-210
-200	-6.471	-6.494	-6.516	-6.538	-6.560	-6.582	-6.604	-6.626	-6.648	-6.670	-6.692	-200
-190	-6.245	-6.268	-6.291	-6.314	-6.336	-6.359	-6.382	-6.404	-6.427	-6.449	-6.471	-190
-180	-6.013	-6.037	-6.060	-6.084	-6.107	-6.130	-6.153	-6.176	-6.199	-6.222	-6.245	-180
-170	-5.776	-5.800	-5.824	-5.848	-5.872	-5.896	-5.919	-5.943	-5.967	-5.990	-6.013	-170
-160	-5.534	-5.559	-5.583	-5.607	-5.632	-5.656	-5.680	-5.704	-5.728	-5.752	-5.776	-160
-150	-5.287	-5.312	-5.337	-5.362	-5.386	-5.411	-5.436	-5.460	-5.485	-5.510	-5.534	-150
-140	-5.034	-5.060	-5.085	-5.111	-5.136	-5.161	-5.186	-5.212	-5.237	-5.262	-5.287	-140
-130	-4.777	-4.803	-4.829	-4.855	-4.880	-4.906	-4.932	-4.958	-4.983	-5.009	-5.034	-130
-120	-4.515	-4.541	-4.567	-4.594	-4.620	-4.646	-4.672	-4.699	-4.725	-4.751	-4.777	-120
-110	-4.248	-4.274	-4.301	-4.328	-4.355	-4.382	-4.408	-4.435	-4.462	-4.488	-4.515	-110
-100	-3.976	-4.003	-4.031	-4.058	-4.085	-4.112	-4.139	-4.167	-4.194	-4.221	-4.248	-100
-90	-3.700	-3.728	-3.755	-3.783	-3.811	-3.838	-3.866	-3.894	-3.921	-3.949	-3.976	-90
-80	-3.419	-3.447	-3.476	-3.504	-3.532	-3.560	-3.588	-3.616	-3.644	-3.672	-3.700	-80
-70	-3.134	-3.163	-3.192	-3.220	-3.249	-3.277	-3.306	-3.334	-3.363	-3.391	-3.419	-70
-60	-2.845	-2.874	-2.903	-2.932	-2.961	-2.990	-3.019	-3.048	-3.077	-3.106	-3.134	-60
-50	-2.552	-2.581	-2.611	-2.640	-2.670	-2.699	-2.728	-2.758	-2.787	-2.816	-2.845	-50
-40	-2.254	-2.284	-2.314	-2.344	-2.374	-2.404	-2.433	-2.463	-2.493	-2.522	-2.552	-40
-30	-1.953	-1.983	-2.014	-2.044	-2.074	-2.104	-2.134	-2.164	-2.194	-2.224	-2.254	-30
-20	-1.648	-1.678	-1.709	-1.740	-1.770	-1.801	-1.831	-1.862	-1.892	-1.923	-1.953	-20
-10	-1.339	-1.370	-1.401	-1.432	-1.463	-1.494	-1.525	-1.555	-1.586	-1.617	-1.648	-10
- 0	-1.026	-1.057	-1.089	-1.120	-1.151	-1.183	-1.214	-1.245	-1.276	-1.308	-1.339	- 0
$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$

TABLE A5.1.2. Type E thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	-1.026	-0.994	-0.963	-0.931	-0.900	-0.868	-0.836	-0.805	-0.773	-0.741	-0.709	0
10	-0.709	-0.677	-0.645	-0.613	-0.581	-0.549	-0.517	-0.485	-0.453	-0.421	-0.389	10
20	-0.389	-0.357	-0.324	-0.292	-0.260	-0.227	-0.195	-0.163	-0.130	-0.098	-0.065	20
30	-0.065	-0.033	0.000	0.033	0.065	0.098	0.131	0.163	0.196	0.229	0.262	30
40	0.262	0.295	0.327	0.360	0.393	0.426	0.459	0.492	0.525	0.558	0.591	40
50	0.591	0.624	0.658	0.691	0.724	0.757	0.790	0.824	0.857	0.890	0.924	50
60	0.924	0.957	0.990	1.024	1.057	1.091	1.124	1.158	1.192	1.225	1.259	60
70	1.259	1.292	1.326	1.360	1.394	1.427	1.461	1.495	1.529	1.563	1.597	70
80	1.597	1.631	1.665	1.699	1.733	1.767	1.801	1.835	1.869	1.903	1.937	80
90	1.937	1.972	2.006	2.040	2.075	2.109	2.143	2.178	2.212	2.247	2.281	90
100	2.281	2.316	2.350	2.385	2.419	2.454	2.489	2.523	2.558	2.593	2.627	100
110	2.627	2.662	2.697	2.732	2.767	2.802	2.837	2.872	2.907	2.942	2.977	110
120	2.977	3.012	3.047	3.082	3.117	3.152	3.187	3.223	3.258	3.293	3.329	120
130	3.329	3.364	3.399	3.435	3.470	3.506	3.541	3.577	3.612	3.648	3.683	130
140	3.683	3.719	3.755	3.790	3.826	3.862	3.898	3.933	3.969	4.005	4.041	140
150	4.041	4.077	4.113	4.149	4.185	4.221	4.257	4.293	4.329	4.365	4.401	150
160	4.401	4.437	4.474	4.510	4.546	4.582	4.619	4.655	4.691	4.728	4.764	160
170	4.764	4.801	4.837	4.874	4.910	4.947	4.983	5.020	5.056	5.093	5.130	170
180	5.130	5.166	5.203	5.240	5.277	5.314	5.350	5.387	5.424	5.461	5.498	180
190	5.498	5.535	5.572	5.609	5.646	5.683	5.720	5.757	5.794	5.832	5.869	190
200	5.869	5.906	5.943	5.981	6.018	6.055	6.092	6.130	6.167	6.205	6.242	200
210	6.242	6.280	6.317	6.355	6.392	6.430	6.467	6.505	6.543	6.580	6.618	210
220	6.618	6.656	6.693	6.731	6.769	6.807	6.845	6.882	6.920	6.958	6.996	220
230	6.996	7.034	7.072	7.110	7.148	7.186	7.224	7.262	7.300	7.339	7.377	230
240	7.377	7.415	7.453	7.491	7.530	7.568	7.606	7.645	7.683	7.721	7.760	240
250	7.760	7.798	7.837	7.875	7.914	7.952	7.991	8.029	8.068	8.106	8.145	250
260	8.145	8.184	8.222	8.261	8.300	8.338	8.377	8.416	8.455	8.494	8.532	260
270	8.532	8.571	8.610	8.649	8.688	8.727	8.766	8.805	8.844	8.883	8.922	270
280	8.922	8.961	9.000	9.039	9.078	9.118	9.157	9.196	9.235	9.274	9.314	280
290	9.314	9.353	9.392	9.432	9.471	9.510	9.550	9.589	9.629	9.668	9.708	290
300	9.708	9.747	9.787	9.826	9.866	9.905	9.945	9.984	10.024	10.064	10.103	300
310	10.103	10.143	10.183	10.223	10.262	10.302	10.342	10.382	10.421	10.461	10.501	310
320	10.501	10.541	10.581	10.621	10.661	10.701	10.741	10.781	10.821	10.861	10.901	320
330	10.901	10.941	10.981	11.021	11.061	11.101	11.142	11.182	11.222	11.262	11.302	330
340	11.302	11.343	11.383	11.423	11.464	11.504	11.544	11.585	11.625	11.665	11.706	340
350	11.706	11.746	11.787	11.827	11.868	11.908	11.949	11.989	12.030	12.070	12.111	350
360	12.111	12.152	12.192	12.233	12.273	12.314	12.355	12.396	12.436	12.477	12.518	360
370	12.518	12.559	12.599	12.640	12.681	12.722	12.763	12.804	12.844	12.885	12.926	370
380	12.926	12.967	13.008	13.049	13.090	13.131	13.172	13.213	13.254	13.295	13.336	380
390	13.336	13.378	13.419	13.460	13.501	13.542	13.583	13.624	13.666	13.707	13.748	390
400	13.748	13.789	13.831	13.872	13.913	13.955	13.996	14.037	14.079	14.120	14.161	400
410	14.161	14.203	14.244	14.286	14.327	14.368	14.410	14.451	14.493	14.534	14.576	410
420	14.576	14.618	14.659	14.701	14.742	14.784	14.826	14.867	14.909	14.950	14.992	420
430	14.992	15.034	15.076	15.117	15.159	15.201	15.243	15.284	15.326	15.368	15.410	430
440	15.410	15.451	15.493	15.535	15.577	15.619	15.661	15.703	15.745	15.787	15.829	440
450	15.829	15.871	15.912	15.954	15.996	16.038	16.080	16.123	16.165	16.207	16.249	450
460	16.249	16.291	16.333	16.375	16.417	16.459	16.501	16.544	16.586	16.628	16.670	460
470	16.670	16.712	16.755	16.797	16.839	16.881	16.924	16.966	17.008	17.051	17.093	470
480	17.093	17.135	17.178	17.220	17.262	17.305	17.347	17.389	17.432	17.474	17.517	480
490	17.517	17.559	17.602	17.644	17.687	17.729	17.772	17.814	17.857	17.899	17.942	490
500	17.942	17.984	18.027	18.070	18.112	18.155	18.197	18.240	18.283	18.325	18.368	500
510	18.368	18.411	18.453	18.496	18.539	18.581	18.624	18.667	18.710	18.752	18.795	510
520	18.795	18.838	18.881	18.924	18.966	19.009	19.052	19.095	19.138	19.181	19.223	520
530	19.223	19.266	19.309	19.352	19.395	19.438	19.481	19.524	19.567	19.610	19.653	530
540	19.653	19.696	19.739	19.782	19.825	19.868	19.911	19.954	19.997	20.040	20.083	540
550	20.083	20.126	20.169	20.212	20.256	20.299	20.342	20.385	20.428	20.471	20.514	550
560	20.514	20.558	20.601	20.644	20.687	20.730	20.774	20.817	20.860	20.903	20.947	560
570	20.947	20.990	21.033	21.076	21.120	21.163	21.206	21.250	21.293	21.336	21.380	570
580	21.380	21.423	21.466	21.510	21.553	21.597	21.640	21.683	21.727	21.770	21.814	580
590	21.814	21.857	21.901	21.944	21.987	22.031	22.074	22.118	22.161	22.205	22.248	590
600	22.248	22.292	22.336	22.379	22.423	22.466	22.510	22.553	22.597	22.640	22.684	600
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A5.1.2. Type E thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	22.248	22.292	22.336	22.379	22.423	22.466	22.510	22.553	22.597	22.640	22.684	600
610	22.684	22.728	22.771	22.815	22.859	22.902	22.946	22.989	23.033	23.077	23.120	610
620	23.120	23.164	23.208	23.252	23.295	23.339	23.383	23.426	23.470	23.514	23.558	620
630	23.558	23.601	23.645	23.689	23.733	23.777	23.820	23.864	23.908	23.952	23.996	630
640	23.996	24.039	24.083	24.127	24.171	24.215	24.259	24.302	24.346	24.390	24.434	640
650	24.434	24.478	24.522	24.566	24.610	24.654	24.698	24.742	24.786	24.829	24.873	650
660	24.873	24.917	24.961	25.005	25.049	25.093	25.137	25.181	25.225	25.269	25.313	660
670	25.313	25.357	25.401	25.445	25.490	25.534	25.578	25.622	25.666	25.710	25.754	670
680	25.754	25.798	25.842	25.886	25.930	25.974	26.019	26.063	26.107	26.151	26.195	680
690	26.195	26.239	26.283	26.328	26.372	26.416	26.460	26.504	26.549	26.593	26.637	690
700	26.637	26.681	26.725	26.770	26.814	26.858	26.902	26.947	26.991	27.035	27.079	700
710	27.079	27.124	27.168	27.212	27.256	27.301	27.345	27.389	27.434	27.478	27.522	710
720	27.522	27.566	27.611	27.655	27.699	27.744	27.788	27.832	27.877	27.921	27.966	720
730	27.966	28.010	28.054	28.099	28.143	28.187	28.232	28.276	28.321	28.365	28.409	730
740	28.409	28.454	28.498	28.543	28.587	28.632	28.676	28.720	28.765	28.809	28.854	740
750	28.854	28.898	28.943	28.987	29.032	29.076	29.121	29.165	29.210	29.254	29.299	750
760	29.299	29.343	29.388	29.432	29.477	29.521	29.566	29.610	29.655	29.699	29.744	760
770	29.744	29.788	29.833	29.878	29.922	29.967	30.011	30.056	30.100	30.145	30.190	770
780	30.190	30.234	30.279	30.323	30.368	30.412	30.457	30.502	30.546	30.591	30.636	780
790	30.636	30.680	30.725	30.769	30.814	30.859	30.903	30.948	30.993	31.037	31.082	790
800	31.082	31.127	31.171	31.216	31.261	31.305	31.350	31.395	31.439	31.484	31.529	800
810	31.529	31.573	31.618	31.663	31.707	31.752	31.797	31.842	31.886	31.931	31.976	810
820	31.976	32.020	32.065	32.110	32.155	32.199	32.244	32.289	32.334	32.378	32.423	820
830	32.423	32.468	32.513	32.557	32.602	32.647	32.692	32.736	32.781	32.826	32.871	830
840	32.871	32.916	32.960	33.005	33.050	33.095	33.140	33.184	33.229	33.274	33.319	840
850	33.319	33.364	33.408	33.453	33.498	33.543	33.588	33.632	33.677	33.722	33.767	850
860	33.767	33.812	33.857	33.901	33.946	33.991	34.036	34.081	34.126	34.170	34.215	860
870	34.215	34.260	34.305	34.350	34.395	34.440	34.484	34.529	34.574	34.619	34.664	870
880	34.664	34.709	34.754	34.798	34.843	34.888	34.933	34.978	35.023	35.068	35.113	880
890	35.113	35.157	35.202	35.247	35.292	35.337	35.382	35.427	35.472	35.517	35.562	890
900	35.562	35.606	35.651	35.696	35.741	35.786	35.831	35.876	35.921	35.966	36.011	900
910	36.011	36.056	36.100	36.145	36.190	36.235	36.280	36.325	36.370	36.415	36.460	910
920	36.460	36.505	36.550	36.595	36.640	36.684	36.729	36.774	36.819	36.864	36.909	920
930	36.909	36.954	36.999	37.044	37.089	37.134	37.179	37.224	37.269	37.314	37.358	930
940	37.358	37.403	37.448	37.493	37.538	37.583	37.628	37.673	37.718	37.763	37.808	940
950	37.808	37.853	37.898	37.943	37.988	38.033	38.078	38.123	38.168	38.213	38.257	950
960	38.257	38.302	38.347	38.392	38.437	38.482	38.527	38.572	38.617	38.662	38.707	960
970	38.707	38.752	38.797	38.842	38.887	38.932	38.977	39.022	39.067	39.112	39.157	970
980	39.157	39.202	39.247	39.291	39.336	39.381	39.426	39.471	39.516	39.561	39.606	980
990	39.606	39.651	39.696	39.741	39.786	39.831	39.876	39.921	39.966	40.011	40.056	990
1,000	40.056	40.101	40.146	40.191	40.236	40.280	40.325	40.370	40.415	40.460	40.505	1,000
1,010	40.505	40.550	40.595	40.640	40.685	40.730	40.775	40.820	40.865	40.910	40.955	1,010
1,020	40.955	41.000	41.045	41.090	41.134	41.179	41.224	41.269	41.314	41.359	41.404	1,020
1,030	41.404	41.449	41.494	41.539	41.584	41.629	41.674	41.719	41.764	41.808	41.853	1,030
1,040	41.853	41.898	41.943	41.988	42.033	42.078	42.123	42.168	42.213	42.258	42.303	1,040
1,050	42.303	42.348	42.392	42.437	42.482	42.527	42.572	42.617	42.662	42.707	42.752	1,050
1,060	42.752	42.797	42.842	42.886	42.931	42.976	43.021	43.066	43.111	43.156	43.201	1,060
1,070	43.201	43.246	43.290	43.335	43.380	43.425	43.470	43.515	43.560	43.605	43.650	1,070
1,080	43.650	43.694	43.739	43.784	43.829	43.874	43.919	43.964	44.008	44.053	44.098	1,080
1,090	44.098	44.143	44.188	44.233	44.278	44.322	44.367	44.412	44.457	44.502	44.547	1,090
1,100	44.547	44.592	44.636	44.681	44.726	44.771	44.816	44.861	44.905	44.950	44.995	1,100
1,110	44.995	45.040	45.085	45.130	45.174	45.219	45.264	45.309	45.354	45.398	45.443	1,110
1,120	45.443	45.488	45.533	45.578	45.622	45.667	45.712	45.757	45.802	45.846	45.891	1,120
1,130	45.891	45.936	45.981	46.025	46.070	46.115	46.160	46.205	46.249	46.294	46.339	1,130
1,140	46.339	46.384	46.428	46.473	46.518	46.563	46.607	46.652	46.697	46.742	46.786	1,140
1,150	46.786	46.831	46.876	46.921	46.965	47.010	47.055	47.099	47.144	47.189	47.234	1,150
1,160	47.234	47.278	47.323	47.368	47.412	47.457	47.502	47.546	47.591	47.636	47.681	1,160
1,170	47.681	47.725	47.770	47.815	47.859	47.904	47.949	47.993	48.038	48.083	48.127	1,170
1,180	48.127	48.172	48.217	48.261	48.306	48.351	48.395	48.440	48.484	48.529	48.574	1,180
1,190	48.574	48.618	48.663	48.708	48.752	48.797	48.842	48.886	48.931	48.975	49.020	1,190
1,200	49.020	49.065	49.109	49.154	49.198	49.243	49.288	49.332	49.377	49.421	49.466	1,200
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A5.1.2. Type E thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,200	49.020	49.065	49.109	49.154	49.198	49.243	49.288	49.332	49.377	49.421	49.466	1,200
1,210	49.466	49.510	49.555	49.600	49.644	49.689	49.733	49.778	49.822	49.867	49.911	1,210
1,220	49.911	49.956	50.001	50.045	50.090	50.134	50.179	50.223	50.268	50.312	50.357	1,220
1,230	50.357	50.401	50.446	50.490	50.535	50.579	50.624	50.668	50.713	50.757	50.802	1,230
1,240	50.802	50.846	50.891	50.935	50.980	51.024	51.069	51.113	51.157	51.202	51.246	1,240
1,250	51.246	51.291	51.335	51.380	51.424	51.469	51.513	51.557	51.602	51.646	51.691	1,250
1,260	51.691	51.735	51.780	51.824	51.868	51.913	51.957	52.002	52.046	52.090	52.135	1,260
1,270	52.135	52.179	52.223	52.268	52.312	52.357	52.401	52.445	52.490	52.534	52.578	1,270
1,280	52.578	52.623	52.667	52.711	52.756	52.800	52.844	52.889	52.933	52.977	53.022	1,280
1,290	53.022	53.066	53.110	53.155	53.199	53.243	53.288	53.332	53.376	53.420	53.465	1,290
1,300	53.465	53.509	53.553	53.597	53.642	53.686	53.730	53.774	53.819	53.863	53.907	1,300
1,310	53.907	53.951	53.996	54.040	54.084	54.128	54.173	54.217	54.261	54.305	54.349	1,310
1,320	54.349	54.394	54.438	54.482	54.526	54.570	54.615	54.659	54.703	54.747	54.791	1,320
1,330	54.791	54.835	54.880	54.924	54.968	55.012	55.056	55.100	55.145	55.189	55.233	1,330
1,340	55.233	55.277	55.321	55.365	55.409	55.453	55.498	55.542	55.586	55.630	55.674	1,340
1,350	55.674	55.718	55.762	55.806	55.850	55.894	55.938	55.982	56.026	56.071	56.115	1,350
1,360	56.115	56.159	56.203	56.247	56.291	56.335	56.379	56.423	56.467	56.511	56.555	1,360
1,370	56.555	56.599	56.643	56.687	56.731	56.775	56.819	56.863	56.907	56.951	56.995	1,370
1,380	56.995	57.039	57.083	57.127	57.171	57.215	57.259	57.303	57.346	57.390	57.434	1,380
1,390	57.434	57.478	57.522	57.566	57.610	57.654	57.698	57.742	57.786	57.830	57.873	1,390
1,400	57.873	57.917	57.961	58.005	58.049	58.093	58.137	58.181	58.224	58.268	58.312	1,400
1,410	58.312	58.356	58.400	58.444	58.487	58.531	58.575	58.619	58.663	58.707	58.750	1,410
1,420	58.750	58.794	58.838	58.882	58.926	58.969	59.013	59.057	59.101	59.144	59.188	1,420
1,430	59.188	59.232	59.276	59.319	59.363	59.407	59.451	59.494	59.538	59.582	59.626	1,430
1,440	59.626	59.669	59.713	59.757	59.800	59.844	59.888	59.932	59.975	60.019	60.063	1,440
1,450	60.063	60.106	60.150	60.194	60.237	60.281	60.325	60.368	60.412	60.455	60.499	1,450
1,460	60.499	60.543	60.586	60.630	60.674	60.717	60.761	60.804	60.848	60.892	60.935	1,460
1,470	60.935	60.979	61.022	61.066	61.109	61.153	61.197	61.240	61.284	61.327	61.371	1,470
1,480	61.371	61.414	61.458	61.501	61.545	61.588	61.632	61.675	61.719	61.762	61.806	1,480
1,490	61.806	61.849	61.893	61.936	61.980	62.023	62.067	62.110	62.154	62.197	62.240	1,490
1,500	62.240	62.284	62.327	62.371	62.414	62.458	62.501	62.544	62.588	62.631	62.675	1,500
1,510	62.675	62.718	62.761	62.805	62.848	62.892	62.935	62.978	63.022	63.065	63.108	1,510
1,520	63.108	63.152	63.195	63.238	63.282	63.325	63.368	63.412	63.455	63.498	63.542	1,520
1,530	63.542	63.585	63.628	63.671	63.715	63.758	63.801	63.844	63.888	63.931	63.974	1,530
1,540	63.974	64.017	64.061	64.104	64.147	64.190	64.234	64.277	64.320	64.363	64.406	1,540
1,550	64.406	64.450	64.493	64.536	64.579	64.622	64.665	64.709	64.752	64.795	64.838	1,550
1,560	64.838	64.881	64.924	64.967	65.011	65.054	65.097	65.140	65.183	65.226	65.269	1,560
1,570	65.269	65.312	65.355	65.398	65.441	65.484	65.528	65.571	65.614	65.657	65.700	1,570
1,580	65.700	65.743	65.786	65.829	65.872	65.915	65.958	66.001	66.044	66.087	66.130	1,580
1,590	66.130	66.173	66.216	66.259	66.302	66.345	66.387	66.430	66.473	66.516	66.559	1,590
1,600	66.559	66.602	66.645	66.688	66.731	66.774	66.817	66.859	66.902	66.945	66.988	1,600
1,610	66.988	67.031	67.074	67.117	67.159	67.202	67.245	67.288	67.331	67.374	67.416	1,610
1,620	67.416	67.459	67.502	67.545	67.588	67.630	67.673	67.716	67.759	67.801	67.844	1,620
1,630	67.844	67.887	67.930	67.972	68.015	68.058	68.101	68.143	68.186	68.229	68.271	1,630
1,640	68.271	68.314	68.357	68.399	68.442	68.485	68.527	68.570	68.613	68.655	68.698	1,640
1,650	68.698	68.740	68.783	68.826	68.868	68.911	68.953	68.996	69.039	69.081	69.124	1,650
1,660	69.124	69.166	69.209	69.251	69.294	69.337	69.379	69.422	69.464	69.507	69.549	1,660
1,670	69.549	69.592	69.634	69.677	69.719	69.762	69.804	69.847	69.889	69.931	69.974	1,670
1,680	69.974	70.016	70.059	70.101	70.144	70.186	70.228	70.271	70.313	70.356	70.398	1,680
1,690	70.398	70.440	70.483	70.525	70.567	70.610	70.652	70.694	70.737	70.779	70.821	1,690
1,700	70.821	70.864	70.906	70.948	70.991	71.033	71.075	71.118	71.160	71.202	71.244	1,700
1,710	71.244	71.287	71.329	71.371	71.413	71.456	71.498	71.540	71.582	71.624	71.667	1,710
1,720	71.667	71.709	71.751	71.793	71.835	71.878	71.920	71.962	72.004	72.046	72.088	1,720
1,730	72.088	72.130	72.173	72.215	72.257	72.299	72.341	72.383	72.425	72.467	72.509	1,730
1,740	72.509	72.551	72.593	72.635	72.678	72.720	72.762	72.804	72.846	72.888	72.930	1,740
1,750	72.930	72.972	73.014	73.056	73.098	73.140	73.182	73.224	73.266	73.308	73.350	1,750
1,760	73.350	73.392	73.434	73.475	73.517	73.559	73.601	73.643	73.685	73.727	73.769	1,760
1,770	73.769	73.811	73.853	73.895	73.936	73.978	74.020	74.062	74.104	74.146	74.188	1,770
1,780	74.188	74.229	74.271	74.313	74.355	74.397	74.439	74.480	74.522	74.564	74.606	1,780
1,790	74.606	74.648	74.689	74.731	74.773	74.815	74.857	74.898	74.940	74.982	75.024	1,790
1,800	75.024	75.065	75.107	75.149	75.191	75.232	75.274	75.316	75.357	75.399	75.441	1,800

°F	0	1	2	3	4	5	6	7	8	9	10	°F
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TABLE A5.1.2. *Type E thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,800	75.024	75.065	75.107	75.149	75.191	75.232	75.274	75.316	75.357	75.399	75.441	1,800
1,810	75.441	75.483	75.524	75.566	75.608	75.649	75.691	75.733	75.774	75.816	75.858	1,810
1,820	75.858	75.899	75.941	75.983	76.024	76.066	76.108	76.149	76.191	76.233	76.274	1,820
1,830	76.274	76.316	76.358									1,830
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A5.1.3. *Type E thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature (°C) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius*

Temperature Range (°C)	a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (μV)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	
I. Quartic Equation											Exact-Approx.
-270 - 0	.....	..	5.9287179	+1	7.0983783	-2	5.2421843	-5	3.8137875	-7	-5 to 5
-200 - 0	.....	..	5.8754764	+1	5.7443085	-2	-5.0637772	-5	1.3960921	-7	-.5 to .4
-200 - 800	.....	..	5.8043714	+1	5.6118501	-2	-5.9506584	-5	2.2327737	-8	-60 to 30
-20 - 500	.....	..	5.8318735	+1	5.4292960	-2	-5.6288941	-5	2.0825828	-8	-8 to 4
0 - 400	.....	..	5.8327591	+1	5.3761106	-2	-5.2870656	-5	1.5352840	-8	-3 to 4
0 - 1000	.....	..	5.8734597	+1	5.0789891	-2	-4.7821793	-5	1.4659118	-8	-18 to 17
400 - 1000	-8.5384268	+2	6.5022632	+1	3.4354900	-2	-2.9769494	-5	7.6039401	-9	-2 to 2.5
600 - 800	-1.3839633	+3	6.7211126	+1	3.1669230	-2	-2.9237913	-5	8.1514671	-9	-.03 to .03
850 - 1000	-5.1503130	+4	-1.6691278	+2	4.1877018	-1	-3.1228607	-4	8.5283044	-8	-.06 to .06
II. Cubic Equation											
-270 - 0	.....	..	5.7649262	+1	3.7510892	-2	-1.5121178	-4	.....	..	-20 to 20
-200 - 0	.....	..	5.8504954	+1	5.0635864	-2	-1.0612630	-4	.....	..	-3 to 3
-200 - 800	.....	..	5.7044679	+1	5.1806781	-2	-3.5013319	-5	.....	..	-250 to 250
-20 - 500	.....	..	5.8796924	+1	4.8523233	-2	-3.6312928	-5	.....	..	-17 to 13
0 - 400	.....	..	5.8518137	+1	5.0966585	-2	-4.0970539	-5	.....	..	-7 to 5
0 - 1000	.....	..	6.1587190	+1	3.4082439	-2	-1.9397672	-5	.....	..	-160 to 110
400 - 1000	-2.3525793	+3	7.4497413	+1	1.2686387	-2	-8.4784615	-6	.....	..	+9 to 10
600 - 800	-3.2950901	+3	7.8254126	+1	7.8232524	-3	-6.4313932	-6	.....	..	-.12 to .12
850 - 1000	-1.0409871	+4	1.0182775	+2	-1.8183746	-2	3.1231863	-6	.....	..	-.5 to .3
Variable reference junction correction											
0 - 50	.....	..	5.8637565	+1	4.6720025	-2	-1.4438022	-5	.....	..	-0.12 to +0.24
III. Quadratic Equation											
-270 - 0	.....	..	6.2504173	+1	9.4465225	-2	.....	..	.....	..	-110 to 160
-200 - 0	.....	..	6.0386870	+1	8.0313966	-2	.....	..	.....	..	-30 to 45
-200 - 800	.....	..	6.1520402	+1	2.0900693	-2	.....	..	.....	..	-1600 to 2700
-20 - 500	.....	..	6.2680031	+1	2.3457699	-2	.....	..	.....	..	-210 to 150
0 - 400	.....	..	6.1330390	+1	2.8334577	-2	.....	..	.....	..	-130 to 90
0 - 1000	.....	..	6.9908648	+1	7.2985032	-3	.....	..	.....	..	-900 to 600
400 - 1000	-4.8897589	+3	8.6430847	+1	-5.1183823	-3	.....	..	.....	..	-70 to 80
600 - 800	-5.4717976	+3	8.7669739	+1	-5.6873749	-3	.....	..	.....	..	-1.9 to 2.2
850 - 1000	-7.9479463	+3	9.3820082	+1	-9.5151917	-3	.....	..	.....	..	-.8 to .6
Variable reference junction correction											
0 - 50	.....	..	5.8654737	+1	4.5614134	-2	.....	..	.....	..	0.0 to +0.2

A5.2. Data for Temperature as a Function of Voltage

The temperature as a function of voltage data given in tables A5.2.1 and A5.2.2 were obtained by iteration in the primary equations for voltage as a function of temperatures. Table A5.2.1 presents the data in millivolts from -9.83 mV to 76.35 mV with temperatures given in degrees Celsius while table A5.2.2 presents similar data with temperatures in degrees Fahrenheit. Table A5.2.3 contains quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges. The error range given in the table represents the difference between the temperature found by iteration in the full precision tables from the text and from the respective reduced order approximations.

TABLE A5.2.1. Type E thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
-9.80	-260.57	-262.45	-264.68	-267.64								-9.80
-9.70	-248.14	-249.13	-250.15	-251.21	-252.32	-253.49	-254.71	-256.01	-257.41	-258.91	-260.57	-9.70
-9.60	-239.69	-240.45	-241.22	-242.01	-242.82	-243.65	-244.50	-245.37	-246.27	-247.19	-248.14	-9.60
-9.50	-232.78	-233.43	-234.08	-234.74	-235.41	-236.10	-236.79	-237.49	-238.21	-238.94	-239.69	-9.50
-9.40	-226.77	-227.34	-227.92	-228.50	-229.09	-229.69	-230.29	-230.90	-231.52	-232.15	-232.78	-9.40
-9.30	-221.34	-221.86	-222.39	-222.92	-223.45	-223.99	-224.54	-225.09	-225.64	-226.20	-226.77	-9.30
-9.20	-216.34	-216.83	-217.31	-217.80	-218.30	-218.80	-219.30	-219.80	-220.31	-220.82	-221.34	-9.20
-9.10	-211.67	-212.12	-212.58	-213.04	-213.50	-213.97	-214.44	-214.91	-215.38	-215.86	-216.34	-9.10
-9.00	-207.25	-207.68	-208.12	-208.55	-208.99	-209.43	-209.87	-210.32	-210.77	-211.21	-211.67	-9.00
-8.90	-203.05	-203.46	-203.88	-204.29	-204.71	-205.13	-205.55	-205.97	-206.40	-206.82	-207.25	-8.90
-8.80	-199.03	-199.42	-199.82	-200.22	-200.62	-201.02	-201.42	-201.83	-202.23	-202.64	-203.05	-8.80
-8.70	-195.16	-195.54	-195.93	-196.31	-196.69	-197.08	-197.47	-197.85	-198.25	-198.64	-199.03	-8.70
-8.60	-191.43	-191.80	-192.17	-192.54	-192.91	-193.28	-193.65	-194.03	-194.41	-194.78	-195.16	-8.60
-8.50	-187.82	-188.17	-188.53	-188.89	-189.25	-189.61	-189.97	-190.33	-190.70	-191.06	-191.43	-8.50
-8.40	-184.31	-184.66	-185.00	-185.35	-185.70	-186.05	-186.40	-186.75	-187.11	-187.46	-187.82	-8.40
-8.30	-180.90	-181.24	-181.57	-181.91	-182.25	-182.59	-182.93	-183.28	-183.62	-183.96	-184.31	-8.30
-8.20	-177.57	-177.90	-178.23	-178.56	-178.89	-179.23	-179.56	-179.89	-180.23	-180.56	-180.90	-8.20
-8.10	-174.33	-174.65	-174.97	-175.29	-175.62	-175.94	-176.27	-176.59	-176.92	-177.25	-177.57	-8.10
-8.00	-171.16	-171.47	-171.78	-172.10	-172.42	-172.73	-173.05	-173.37	-173.69	-174.01	-174.33	-8.00
-7.90	-168.05	-168.36	-168.67	-168.97	-169.28	-169.59	-169.91	-170.22	-170.53	-170.84	-171.16	-7.90
-7.80	-165.01	-165.31	-165.61	-165.91	-166.22	-166.52	-166.82	-167.13	-167.44	-167.74	-168.05	-7.80
-7.70	-162.02	-162.32	-162.61	-162.91	-163.21	-163.51	-163.80	-164.10	-164.40	-164.70	-165.01	-7.70
-7.60	-159.09	-159.38	-159.67	-159.96	-160.25	-160.55	-160.84	-161.13	-161.43	-161.72	-162.02	-7.60
-7.50	-156.21	-156.49	-156.78	-157.07	-157.35	-157.64	-157.93	-158.22	-158.51	-158.80	-159.09	-7.50
-7.40	-153.37	-153.65	-153.94	-154.22	-154.50	-154.78	-155.07	-155.35	-155.64	-155.92	-156.21	-7.40
-7.30	-150.58	-150.86	-151.14	-151.41	-151.69	-151.97	-152.25	-152.53	-152.81	-153.09	-153.37	-7.30
-7.20	-147.83	-148.11	-148.38	-148.65	-148.93	-149.20	-149.48	-149.75	-150.03	-150.31	-150.58	-7.20
-7.10	-145.13	-145.40	-145.66	-145.93	-146.20	-146.48	-146.75	-147.02	-147.29	-147.56	-147.83	-7.10
-7.00	-142.46	-142.72	-142.99	-143.25	-143.52	-143.79	-144.05	-144.32	-144.59	-144.86	-145.13	-7.00
-6.90	-139.82	-140.08	-140.34	-140.61	-140.87	-141.13	-141.40	-141.66	-141.93	-142.19	-142.46	-6.90
-6.80	-137.22	-137.48	-137.74	-138.00	-138.26	-138.52	-138.78	-139.04	-139.30	-139.56	-139.82	-6.80
-6.70	-134.65	-134.91	-135.16	-135.42	-135.67	-135.93	-136.19	-136.45	-136.70	-136.96	-137.22	-6.70
-6.60	-132.11	-132.36	-132.62	-132.87	-133.12	-133.38	-133.63	-133.89	-134.14	-134.39	-134.65	-6.60
-6.50	-129.60	-129.85	-130.10	-130.35	-130.60	-130.85	-131.10	-131.36	-131.61	-131.86	-132.11	-6.50
-6.40	-127.12	-127.37	-127.62	-127.86	-128.11	-128.36	-128.61	-128.86	-129.10	-129.35	-129.60	-6.40
-6.30	-124.67	-124.91	-125.16	-125.40	-125.65	-125.89	-126.14	-126.38	-126.63	-126.88	-127.12	-6.30
-6.20	-122.24	-122.48	-122.72	-122.97	-123.21	-123.45	-123.69	-123.94	-124.18	-124.42	-124.67	-6.20
-6.10	-119.84	-120.08	-120.32	-120.56	-120.80	-121.04	-121.28	-121.52	-121.76	-122.00	-122.24	-6.10
-6.00	-117.46	-117.70	-117.93	-118.17	-118.41	-118.64	-118.88	-119.12	-119.36	-119.60	-119.84	-6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. *Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
-6.00	-117.46	-117.70	-117.93	-118.17	-118.41	-118.64	-118.88	-119.12	-119.36	-119.60	-119.84	-6.00
-5.90	-115.10	-115.34	-115.57	-115.81	-116.04	-116.28	-116.51	-116.75	-116.99	-117.22	-117.46	-5.90
-5.80	-112.77	-113.00	-113.23	-113.47	-113.70	-113.93	-114.17	-114.40	-114.63	-114.87	-115.10	-5.80
-5.70	-110.46	-110.69	-110.92	-111.15	-111.38	-111.61	-111.84	-112.07	-112.30	-112.54	-112.77	-5.70
-5.60	-108.16	-108.39	-108.62	-108.85	-109.08	-109.31	-109.54	-109.77	-110.00	-110.23	-110.46	-5.60
-5.50	-105.89	-106.12	-106.35	-106.57	-106.80	-107.03	-107.25	-107.48	-107.71	-107.94	-108.16	-5.50
-5.40	-103.64	-103.86	-104.09	-104.31	-104.54	-104.76	-104.99	-105.21	-105.44	-105.67	-105.89	-5.40
-5.30	-101.41	-101.63	-101.85	-102.07	-102.30	-102.52	-102.74	-102.97	-103.19	-103.42	-103.64	-5.30
-5.20	-99.19	-99.41	-99.63	-99.85	-100.07	-100.30	-100.52	-100.74	-100.96	-101.18	-101.41	-5.20
-5.10	-96.99	-97.21	-97.43	-97.65	-97.87	-98.09	-98.31	-98.53	-98.75	-98.97	-99.19	-5.10
-5.00	-94.81	-95.03	-95.25	-95.46	-95.68	-95.90	-96.12	-96.34	-96.55	-96.77	-96.99	-5.00
-4.90	-92.64	-92.86	-93.08	-93.29	-93.51	-93.73	-93.94	-94.16	-94.38	-94.59	-94.81	-4.90
-4.80	-90.50	-90.71	-90.92	-91.14	-91.35	-91.57	-91.78	-92.00	-92.21	-92.43	-92.64	-4.80
-4.70	-88.36	-88.57	-88.79	-89.00	-89.21	-89.43	-89.64	-89.85	-90.07	-90.28	-90.50	-4.70
-4.60	-86.24	-86.45	-86.67	-86.88	-87.09	-87.30	-87.51	-87.72	-87.94	-88.15	-88.36	-4.60
-4.50	-84.14	-84.35	-84.56	-84.77	-84.98	-85.19	-85.40	-85.61	-85.82	-86.03	-86.24	-4.50
-4.40	-82.05	-82.26	-82.47	-82.67	-82.88	-83.09	-83.30	-83.51	-83.72	-83.93	-84.14	-4.40
-4.30	-79.97	-80.18	-80.39	-80.59	-80.80	-81.01	-81.22	-81.42	-81.63	-81.84	-82.05	-4.30
-4.20	-77.91	-78.12	-78.32	-78.53	-78.73	-78.94	-79.15	-79.35	-79.56	-79.77	-79.97	-4.20
-4.10	-75.86	-76.06	-76.27	-76.47	-76.68	-76.88	-77.09	-77.29	-77.50	-77.70	-77.91	-4.10
-4.00	-73.82	-74.03	-74.23	-74.43	-74.64	-74.84	-75.04	-75.25	-75.45	-75.66	-75.86	-4.00
-3.90	-71.80	-72.00	-72.20	-72.40	-72.61	-72.81	-73.01	-73.21	-73.42	-73.62	-73.82	-3.90
-3.80	-69.78	-69.98	-70.19	-70.39	-70.59	-70.79	-70.99	-71.19	-71.39	-71.59	-71.80	-3.80
-3.70	-67.78	-67.98	-68.18	-68.38	-68.58	-68.78	-68.98	-69.18	-69.38	-69.58	-69.78	-3.70
-3.60	-65.79	-65.99	-66.19	-66.39	-66.59	-66.79	-66.98	-67.18	-67.38	-67.58	-67.78	-3.60
-3.50	-63.81	-64.01	-64.21	-64.41	-64.60	-64.80	-65.00	-65.20	-65.40	-65.59	-65.79	-3.50
-3.40	-61.85	-62.04	-62.24	-62.43	-62.63	-62.83	-63.02	-63.22	-63.42	-63.62	-63.81	-3.40
-3.30	-59.89	-60.08	-60.28	-60.47	-60.67	-60.87	-61.06	-61.26	-61.45	-61.65	-61.85	-3.30
-3.20	-57.94	-58.13	-58.33	-58.52	-58.72	-58.91	-59.11	-59.30	-59.50	-59.69	-59.89	-3.20
-3.10	-56.00	-56.20	-56.39	-56.58	-56.78	-56.97	-57.16	-57.36	-57.55	-57.75	-57.94	-3.10
-3.00	-54.08	-54.27	-54.46	-54.65	-54.85	-55.04	-55.23	-55.42	-55.62	-55.81	-56.00	-3.00
-2.90	-52.16	-52.35	-52.54	-52.73	-52.92	-53.12	-53.31	-53.50	-53.69	-53.88	-54.08	-2.90
-2.80	-50.25	-50.44	-50.63	-50.82	-51.01	-51.20	-51.39	-51.59	-51.78	-51.97	-52.16	-2.80
-2.70	-48.35	-48.54	-48.73	-48.92	-49.11	-49.30	-49.49	-49.68	-49.87	-50.06	-50.25	-2.70
-2.60	-46.46	-46.65	-46.84	-47.03	-47.22	-47.41	-47.60	-47.78	-47.97	-48.16	-48.35	-2.60
-2.50	-44.58	-44.77	-44.96	-45.15	-45.33	-45.52	-45.71	-45.90	-46.09	-46.27	-46.46	-2.50
-2.40	-42.71	-42.90	-43.08	-43.27	-43.46	-43.64	-43.83	-44.02	-44.21	-44.39	-44.58	-2.40
-2.30	-40.85	-41.03	-41.22	-41.40	-41.59	-41.78	-41.96	-42.15	-42.34	-42.52	-42.71	-2.30
-2.20	-38.99	-39.18	-39.36	-39.55	-39.73	-39.92	-40.10	-40.29	-40.47	-40.66	-40.85	-2.20
-2.10	-37.14	-37.33	-37.51	-37.70	-37.88	-38.07	-38.25	-38.44	-38.62	-38.81	-38.99	-2.10
-2.00	-35.31	-35.49	-35.67	-35.86	-36.04	-36.22	-36.41	-36.59	-36.78	-36.96	-37.14	-2.00
-1.90	-33.47	-33.66	-33.84	-34.02	-34.21	-34.39	-34.57	-34.75	-34.94	-35.12	-35.31	-1.90
-1.80	-31.65	-31.83	-32.01	-32.20	-32.38	-32.56	-32.74	-32.93	-33.11	-33.29	-33.47	-1.80
-1.70	-29.83	-30.02	-30.20	-30.38	-30.56	-30.74	-30.92	-31.10	-31.29	-31.47	-31.65	-1.70
-1.60	-28.03	-28.21	-28.39	-28.57	-28.75	-28.93	-29.11	-29.29	-29.47	-29.65	-29.83	-1.60
-1.50	-26.22	-26.40	-26.58	-26.76	-26.94	-27.12	-27.30	-27.48	-27.67	-27.85	-28.03	-1.50
-1.40	-24.43	-24.61	-24.79	-24.97	-25.15	-25.33	-25.51	-25.69	-25.87	-26.05	-26.22	-1.40
-1.30	-22.64	-22.82	-23.00	-23.18	-23.36	-23.54	-23.72	-23.89	-24.07	-24.25	-24.43	-1.30
-1.20	-20.86	-21.04	-21.22	-21.40	-21.57	-21.75	-21.93	-22.11	-22.29	-22.47	-22.64	-1.20
-1.10	-19.09	-19.27	-19.44	-19.62	-19.80	-19.98	-20.15	-20.33	-20.51	-20.69	-20.86	-1.10
-1.00	-17.32	-17.50	-17.68	-17.85	-18.03	-18.21	-18.38	-18.56	-18.74	-18.91	-19.09	-1.00
-0.90	-15.56	-15.74	-15.92	-16.09	-16.27	-16.44	-16.62	-16.79	-16.97	-17.15	-17.32	-0.90
-0.80	-13.81	-13.99	-14.16	-14.34	-14.51	-14.69	-14.86	-15.04	-15.21	-15.39	-15.56	-0.80
-0.70	-12.06	-12.24	-12.41	-12.59	-12.76	-12.94	-13.11	-13.29	-13.46	-13.64	-13.81	-0.70
-0.60	-10.32	-10.50	-10.67	-10.84	-11.02	-11.19	-11.37	-11.54	-11.71	-11.89	-12.06	-0.60
-0.50	-8.59	-8.76	-8.93	-9.11	-9.28	-9.45	-9.63	-9.80	-9.97	-10.15	-10.32	-0.50
-0.40	-6.86	-7.03	-7.20	-7.38	-7.55	-7.72	-7.89	-8.07	-8.24	-8.41	-8.59	-0.40
-0.30	-5.14	-5.31	-5.48	-5.65	-5.82	-6.00	-6.17	-6.34	-6.51	-6.69	-6.86	-0.30
-0.20	-3.42	-3.59	-3.76	-3.93	-4.10	-4.28	-4.45	-4.62	-4.79	-4.96	-5.14	-0.20
-0.10	-1.71	-1.88	-2.05	-2.22	-2.39	-2.56	-2.73	-2.90	-3.08	-3.25	-3.42	-0.10
-0.00	0.00	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.54	1.71	0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. *Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
0.00	0.00	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	0.00
0.10	1.70	1.87	2.04	2.21	2.38	2.55	2.72	2.89	3.06	3.23	3.40	0.10
0.20	3.40	3.57	3.74	3.91	4.08	4.25	4.42	4.58	4.75	4.92	5.09	0.20
0.30	5.09	5.26	5.43	5.60	5.77	5.94	6.11	6.27	6.44	6.61	6.78	0.30
0.40	6.78	6.95	7.12	7.29	7.46	7.62	7.79	7.96	8.13	8.30	8.47	0.40
0.50	8.47	8.63	8.80	8.97	9.14	9.31	9.47	9.64	9.81	9.98	10.15	0.50
0.60	10.15	10.31	10.48	10.65	10.82	10.98	11.15	11.32	11.49	11.65	11.82	0.60
0.70	11.82	11.99	12.16	12.32	12.49	12.66	12.83	12.99	13.16	13.33	13.49	0.70
0.80	13.49	13.66	13.83	13.99	14.16	14.33	14.49	14.66	14.83	14.99	15.16	0.80
0.90	15.16	15.33	15.49	15.66	15.83	15.99	16.16	16.33	16.49	16.66	16.83	0.90
1.00	16.83	16.99	17.16	17.32	17.49	17.66	17.82	17.99	18.15	18.32	18.48	1.00
1.10	18.48	18.65	18.82	18.98	19.15	19.31	19.48	19.64	19.81	19.97	20.14	1.10
1.20	20.14	20.31	20.47	20.64	20.80	20.97	21.13	21.30	21.46	21.63	21.79	1.20
1.30	21.79	21.96	22.12	22.29	22.45	22.62	22.78	22.94	23.11	23.27	23.44	1.30
1.40	23.44	23.60	23.77	23.93	24.10	24.26	24.42	24.59	24.75	24.92	25.08	1.40
1.50	25.08	25.25	25.41	25.57	25.74	25.90	26.07	26.23	26.39	26.56	26.72	1.50
1.60	26.72	26.88	27.05	27.21	27.38	27.54	27.70	27.87	28.03	28.19	28.36	1.60
1.70	28.36	28.52	28.68	28.85	29.01	29.17	29.33	29.50	29.66	29.82	29.99	1.70
1.80	29.99	30.15	30.31	30.48	30.64	30.80	30.96	31.13	31.29	31.45	31.61	1.80
1.90	31.61	31.78	31.94	32.10	32.26	32.43	32.59	32.75	32.91	33.07	33.24	1.90
2.00	33.24	33.40	33.56	33.72	33.89	34.05	34.21	34.37	34.53	34.69	34.86	2.00
2.10	34.86	35.02	35.18	35.34	35.50	35.66	35.83	35.99	36.15	36.31	36.47	2.10
2.20	36.47	36.63	36.79	36.96	37.12	37.28	37.44	37.60	37.76	37.92	38.08	2.20
2.30	38.08	38.24	38.41	38.57	38.73	38.89	39.05	39.21	39.37	39.53	39.69	2.30
2.40	39.69	39.85	40.01	40.17	40.33	40.49	40.65	40.81	40.97	41.13	41.30	2.40
2.50	41.30	41.46	41.62	41.78	41.94	42.10	42.26	42.42	42.58	42.74	42.90	2.50
2.60	42.90	43.06	43.21	43.37	43.53	43.69	43.85	44.01	44.17	44.33	44.49	2.60
2.70	44.49	44.65	44.81	44.97	45.13	45.29	45.45	45.61	45.77	45.93	46.08	2.70
2.80	46.08	46.24	46.40	46.56	46.72	46.88	47.04	47.20	47.36	47.52	47.67	2.80
2.90	47.67	47.83	47.99	48.15	48.31	48.47	48.63	48.78	48.94	49.10	49.26	2.90
3.00	49.26	49.42	49.58	49.73	49.89	50.05	50.21	50.37	50.53	50.68	50.84	3.00
3.10	50.84	51.00	51.16	51.32	51.47	51.63	51.79	51.95	52.10	52.26	52.42	3.10
3.20	52.42	52.58	52.73	52.89	53.05	53.21	53.36	53.52	53.68	53.84	53.99	3.20
3.30	53.99	54.15	54.31	54.47	54.62	54.78	54.94	55.09	55.25	55.41	55.57	3.30
3.40	55.57	55.72	55.88	56.04	56.19	56.35	56.51	56.66	56.82	56.98	57.13	3.40
3.50	57.13	57.29	57.45	57.60	57.76	57.92	58.07	58.23	58.39	58.54	58.70	3.50
3.60	58.70	58.85	59.01	59.17	59.32	59.48	59.63	59.79	59.95	60.10	60.26	3.60
3.70	60.26	60.41	60.57	60.73	60.88	61.04	61.19	61.35	61.51	61.66	61.82	3.70
3.80	61.82	61.97	62.13	62.28	62.44	62.59	62.75	62.90	63.06	63.22	63.37	3.80
3.90	63.37	63.53	63.68	63.84	63.99	64.15	64.30	64.46	64.61	64.77	64.92	3.90
4.00	64.92	65.08	65.23	65.39	65.54	65.70	65.85	66.01	66.16	66.31	66.47	4.00
4.10	66.47	66.62	66.78	66.93	67.09	67.24	67.40	67.55	67.71	67.86	68.01	4.10
4.20	68.01	68.17	68.32	68.48	68.63	68.78	68.94	69.09	69.25	69.40	69.55	4.20
4.30	69.55	69.71	69.86	70.02	70.17	70.32	70.48	70.63	70.79	70.94	71.09	4.30
4.40	71.09	71.25	71.40	71.55	71.71	71.86	72.01	72.17	72.32	72.47	72.63	4.40
4.50	72.63	72.78	72.93	73.09	73.24	73.39	73.55	73.70	73.85	74.01	74.16	4.50
4.60	74.16	74.31	74.47	74.62	74.77	74.92	75.08	75.23	75.38	75.53	75.69	4.60
4.70	75.69	75.84	75.99	76.15	76.30	76.45	76.60	76.76	76.91	77.06	77.21	4.70
4.80	77.21	77.37	77.52	77.67	77.82	77.97	78.13	78.28	78.43	78.58	78.74	4.80
4.90	78.74	78.89	79.04	79.19	79.34	79.50	79.65	79.80	79.95	80.10	80.26	4.90
5.00	80.26	80.41	80.56	80.71	80.86	81.01	81.17	81.32	81.47	81.62	81.77	5.00
5.10	81.77	81.92	82.07	82.23	82.38	82.53	82.68	82.83	82.98	83.13	83.29	5.10
5.20	83.29	83.44	83.59	83.74	83.89	84.04	84.19	84.34	84.49	84.64	84.80	5.20
5.30	84.80	84.95	85.10	85.25	85.40	85.55	85.70	85.85	86.00	86.15	86.30	5.30
5.40	86.30	86.45	86.60	86.76	86.91	87.06	87.21	87.36	87.51	87.66	87.81	5.40
5.50	87.81	87.96	88.11	88.26	88.41	88.56	88.71	88.86	89.01	89.16	89.31	5.50
5.60	89.31	89.46	89.61	89.76	89.91	90.06	90.21	90.36	90.51	90.66	90.81	5.60
5.70	90.81	90.96	91.11	91.26	91.41	91.56	91.71	91.86	92.01	92.16	92.31	5.70
5.80	92.31	92.46	92.60	92.75	92.90	93.05	93.20	93.35	93.50	93.65	93.80	5.80
5.90	93.80	93.95	94.10	94.25	94.40	94.55	94.69	94.84	94.99	95.14	95.29	5.90
6.00	95.29	95.44	95.59	95.74	95.89	96.03	96.18	96.33	96.48	96.63	96.78	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. *Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
6.00	95.29	95.44	95.59	95.74	95.89	96.03	96.18	96.33	96.48	96.63	96.78	6.00
6.10	96.78	96.93	97.08	97.22	97.37	97.52	97.67	97.82	97.97	98.12	98.26	6.10
6.20	98.26	98.41	98.56	98.71	98.86	99.01	99.15	99.30	99.45	99.60	99.75	6.20
6.30	99.75	99.90	100.04	100.19	100.34	100.49	100.64	100.78	100.93	101.08	101.23	6.30
6.40	101.23	101.38	101.52	101.67	101.82	101.97	102.11	102.26	102.41	102.56	102.71	6.40
6.50	102.71	102.85	103.00	103.15	103.30	103.44	103.59	103.74	103.89	104.03	104.18	6.50
6.60	104.18	104.33	104.48	104.62	104.77	104.92	105.06	105.21	105.36	105.51	105.65	6.60
6.70	105.65	105.80	105.95	106.09	106.24	106.39	106.54	106.68	106.83	106.98	107.12	6.70
6.80	107.12	107.27	107.42	107.56	107.71	107.86	108.00	108.15	108.30	108.44	108.59	6.80
6.90	108.59	108.74	108.88	109.03	109.18	109.32	109.47	109.62	109.76	109.91	110.06	6.90
7.00	110.06	110.20	110.35	110.50	110.64	110.79	110.93	111.08	111.23	111.37	111.52	7.00
7.10	111.52	111.67	111.81	111.96	112.10	112.25	112.40	112.54	112.69	112.83	112.98	7.10
7.20	112.98	113.13	113.27	113.42	113.56	113.71	113.86	114.00	114.15	114.29	114.44	7.20
7.30	114.44	114.58	114.73	114.88	115.02	115.17	115.31	115.46	115.60	115.75	115.89	7.30
7.40	115.89	116.04	116.18	116.33	116.48	116.62	116.77	116.91	117.06	117.20	117.35	7.40
7.50	117.35	117.49	117.64	117.78	117.93	118.07	118.22	118.36	118.51	118.65	118.80	7.50
7.60	118.80	118.94	119.09	119.23	119.38	119.52	119.67	119.81	119.96	120.10	120.25	7.60
7.70	120.25	120.39	120.54	120.68	120.83	120.97	121.12	121.26	121.40	121.55	121.69	7.70
7.80	121.69	121.84	121.98	122.13	122.27	122.42	122.56	122.71	122.85	122.99	123.14	7.80
7.90	123.14	123.28	123.43	123.57	123.72	123.86	124.00	124.15	124.29	124.44	124.58	7.90
8.00	124.58	124.72	124.87	125.01	125.16	125.30	125.44	125.59	125.73	125.88	126.02	8.00
8.10	126.02	126.16	126.31	126.45	126.60	126.74	126.88	127.03	127.17	127.31	127.46	8.10
8.20	127.46	127.60	127.75	127.89	128.03	128.18	128.32	128.46	128.61	128.75	128.89	8.20
8.30	128.89	129.04	129.18	129.32	129.47	129.61	129.75	129.90	130.04	130.18	130.33	8.30
8.40	130.33	130.47	130.61	130.76	130.90	131.04	131.19	131.33	131.47	131.62	131.76	8.40
8.50	131.76	131.90	132.05	132.19	132.33	132.47	132.62	132.76	132.90	133.05	133.19	8.50
8.60	133.19	133.33	133.47	133.62	133.76	133.90	134.05	134.19	134.33	134.47	134.62	8.60
8.70	134.62	134.76	134.90	135.04	135.19	135.33	135.47	135.61	135.76	135.90	136.04	8.70
8.80	136.04	136.18	136.33	136.47	136.61	136.75	136.90	137.04	137.18	137.32	137.47	8.80
8.90	137.47	137.61	137.75	137.89	138.03	138.18	138.32	138.46	138.60	138.74	138.89	8.90
9.00	138.89	139.03	139.17	139.31	139.45	139.60	139.74	139.88	140.02	140.16	140.31	9.00
9.10	140.31	140.45	140.59	140.73	140.87	141.02	141.16	141.30	141.44	141.58	141.72	9.10
9.20	141.72	141.87	142.01	142.15	142.29	142.43	142.57	142.71	142.86	143.00	143.14	9.20
9.30	143.14	143.28	143.42	143.56	143.70	143.85	143.99	144.13	144.27	144.41	144.55	9.30
9.40	144.55	144.69	144.84	144.98	145.12	145.26	145.40	145.54	145.68	145.82	145.96	9.40
9.50	145.96	146.11	146.25	146.39	146.53	146.67	146.81	146.95	147.09	147.23	147.37	9.50
9.60	147.37	147.52	147.66	147.80	147.94	148.08	148.22	148.36	148.50	148.64	148.78	9.60
9.70	148.78	148.92	149.06	149.20	149.35	149.49	149.63	149.77	149.91	150.05	150.19	9.70
9.80	150.19	150.33	150.47	150.61	150.75	150.89	151.03	151.17	151.31	151.45	151.59	9.80
9.90	151.59	151.73	151.87	152.01	152.15	152.30	152.44	152.58	152.72	152.86	153.00	9.90
10.00	153.00	153.14	153.28	153.42	153.56	153.70	153.84	153.98	154.12	154.26	154.40	10.00
10.10	154.40	154.54	154.68	154.82	154.96	155.10	155.24	155.38	155.52	155.66	155.80	10.10
10.20	155.80	155.94	156.08	156.22	156.36	156.50	156.64	156.77	156.91	157.05	157.19	10.20
10.30	157.19	157.33	157.47	157.61	157.75	157.89	158.03	158.17	158.31	158.45	158.59	10.30
10.40	158.59	158.73	158.87	159.01	159.15	159.29	159.43	159.57	159.71	159.84	159.98	10.40
10.50	159.98	160.12	160.26	160.40	160.54	160.68	160.82	160.96	161.10	161.24	161.38	10.50
10.60	161.38	161.52	161.65	161.79	161.93	162.07	162.21	162.35	162.49	162.63	162.77	10.60
10.70	162.77	162.91	163.04	163.18	163.32	163.46	163.60	163.74	163.88	164.02	164.16	10.70
10.80	164.16	164.29	164.43	164.57	164.71	164.85	164.99	165.13	165.27	165.40	165.54	10.80
10.90	165.54	165.68	165.82	165.96	166.10	166.24	166.38	166.51	166.65	166.79	166.93	10.90
11.00	166.93	167.07	167.21	167.34	167.48	167.62	167.76	167.90	168.04	168.18	168.31	11.00
11.10	168.31	168.45	168.59	168.73	168.87	169.01	169.14	169.28	169.42	169.56	169.70	11.10
11.20	169.70	169.83	169.97	170.11	170.25	170.39	170.53	170.66	170.80	170.94	171.08	11.20
11.30	171.08	171.22	171.35	171.49	171.63	171.77	171.91	172.04	172.18	172.32	172.46	11.30
11.40	172.46	172.59	172.73	172.87	173.01	173.15	173.28	173.42	173.56	173.70	173.84	11.40
11.50	173.84	173.97	174.11	174.25	174.39	174.52	174.66	174.80	174.94	175.07	175.21	11.50
11.60	175.21	175.35	175.49	175.62	175.76	175.90	176.04	176.17	176.31	176.45	176.59	11.60
11.70	176.59	176.72	176.86	177.00	177.14	177.27	177.41	177.55	177.69	177.82	177.96	11.70
11.80	177.96	178.10	178.23	178.37	178.51	178.65	178.78	178.92	179.06	179.20	179.33	11.80
11.90	179.33	179.47	179.61	179.74	179.88	180.02	180.16	180.29	180.43	180.57	180.70	11.90
12.00	180.70	180.84	180.98	181.11	181.25	181.39	181.52	181.66	181.80	181.94	182.07	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. *Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPITS 1968)												
12.00	180.70	180.84	180.98	181.11	181.25	181.39	181.52	181.66	181.80	181.94	182.07	12.00
12.10	182.07	182.21	182.35	182.48	182.62	182.76	182.89	183.03	183.17	183.30	183.44	12.10
12.20	183.44	183.58	183.71	183.85	183.99	184.12	184.26	184.40	184.53	184.67	184.81	12.20
12.30	184.81	184.94	185.08	185.22	185.35	185.49	185.63	185.76	185.90	186.04	186.17	12.30
12.40	186.17	186.31	186.44	186.58	186.72	186.85	186.99	187.13	187.26	187.40	187.54	12.40
12.50	187.54	187.67	187.81	187.94	188.08	188.22	188.35	188.49	188.63	188.76	188.90	12.50
12.60	188.90	189.03	189.17	189.31	189.44	189.58	189.71	189.85	189.99	190.12	190.26	12.60
12.70	190.26	190.39	190.53	190.67	190.80	190.94	191.07	191.21	191.35	191.48	191.62	12.70
12.80	191.62	191.75	191.89	192.03	192.16	192.30	192.43	192.57	192.70	192.84	192.98	12.80
12.90	192.98	193.11	193.25	193.38	193.52	193.65	193.79	193.93	194.06	194.20	194.33	12.90
13.00	194.33	194.47	194.60	194.74	194.88	195.01	195.15	195.28	195.42	195.55	195.69	13.00
13.10	195.69	195.82	195.96	196.10	196.23	196.37	196.50	196.64	196.77	196.91	197.04	13.10
13.20	197.04	197.18	197.31	197.45	197.58	197.72	197.86	197.99	198.13	198.26	198.40	13.20
13.30	198.40	198.53	198.67	198.80	198.94	199.07	199.21	199.34	199.48	199.61	199.75	13.30
13.40	199.75	199.88	200.02	200.15	200.29	200.42	200.56	200.69	200.83	200.96	201.10	13.40
13.50	201.10	201.23	201.37	201.50	201.64	201.77	201.91	202.04	202.18	202.31	202.45	13.50
13.60	202.45	202.58	202.72	202.85	202.99	203.12	203.26	203.39	203.53	203.66	203.80	13.60
13.70	203.80	203.93	204.07	204.20	204.34	204.47	204.60	204.74	204.87	205.01	205.14	13.70
13.80	205.14	205.28	205.41	205.55	205.68	205.82	205.95	206.09	206.22	206.35	206.49	13.80
13.90	206.49	206.62	206.76	206.89	207.03	207.16	207.30	207.43	207.56	207.70	207.83	13.90
14.00	207.83	207.97	208.10	208.24	208.37	208.51	208.64	208.77	208.91	209.04	209.18	14.00
14.10	209.18	209.31	209.45	209.58	209.71	209.85	209.98	210.12	210.25	210.38	210.52	14.10
14.20	210.52	210.65	210.79	210.92	211.06	211.19	211.32	211.46	211.59	211.73	211.86	14.20
14.30	211.86	211.99	212.13	212.26	212.40	212.53	212.66	212.80	212.93	213.07	213.20	14.30
14.40	213.20	213.33	213.47	213.60	213.74	213.87	214.00	214.14	214.27	214.40	214.54	14.40
14.50	214.54	214.67	214.81	214.94	215.07	215.21	215.34	215.47	215.61	215.74	215.88	14.50
14.60	215.88	216.01	216.14	216.28	216.41	216.54	216.68	216.81	216.95	217.08	217.21	14.60
14.70	217.21	217.35	217.48	217.61	217.75	217.88	218.01	218.15	218.28	218.41	218.55	14.70
14.80	218.55	218.68	218.82	218.95	219.08	219.22	219.35	219.48	219.62	219.75	219.88	14.80
14.90	219.88	220.02	220.15	220.28	220.42	220.55	220.68	220.82	220.95	221.08	221.22	14.90
15.00	221.22	221.35	221.48	221.62	221.75	221.88	222.02	222.15	222.28	222.41	222.55	15.00
15.10	222.55	222.68	222.81	222.95	223.08	223.21	223.35	223.48	223.61	223.75	223.88	15.10
15.20	223.88	224.01	224.15	224.28	224.41	224.54	224.68	224.81	224.94	225.08	225.21	15.20
15.30	225.21	225.34	225.48	225.61	225.74	225.88	226.01	226.14	226.27	226.41	226.54	15.30
15.40	226.54	226.67	226.80	226.94	227.07	227.20	227.34	227.47	227.60	227.73	227.87	15.40
15.50	227.87	228.00	228.13	228.26	228.40	228.53	228.66	228.80	228.93	229.06	229.19	15.50
15.60	229.19	229.33	229.46	229.59	229.72	229.86	229.99	230.12	230.25	230.39	230.52	15.60
15.70	230.52	230.65	230.78	230.92	231.05	231.18	231.31	231.45	231.58	231.71	231.84	15.70
15.80	231.84	231.98	232.11	232.24	232.37	232.51	232.64	232.77	232.90	233.04	233.17	15.80
15.90	233.17	233.30	233.43	233.57	233.70	233.83	233.96	234.09	234.23	234.36	234.49	15.90
16.00	234.49	234.62	234.76	234.89	235.02	235.15	235.28	235.42	235.55	235.68	235.81	16.00
16.10	235.81	235.95	236.08	236.21	236.34	236.47	236.61	236.74	236.87	237.00	237.13	16.10
16.20	237.13	237.27	237.40	237.53	237.66	237.79	237.93	238.06	238.19	238.32	238.45	16.20
16.30	238.45	238.59	238.72	238.85	238.98	239.11	239.25	239.38	239.51	239.64	239.77	16.30
16.40	239.77	239.91	240.04	240.17	240.30	240.43	240.56	240.70	240.83	240.96	241.09	16.40
16.50	241.09	241.22	241.36	241.49	241.62	241.75	241.88	242.01	242.15	242.28	242.41	16.50
16.60	242.41	242.54	242.67	242.80	242.94	243.07	243.20	243.33	243.46	243.59	243.73	16.60
16.70	243.73	243.86	243.99	244.12	244.25	244.38	244.52	244.65	244.78	244.91	245.04	16.70
16.80	245.04	245.17	245.30	245.44	245.57	245.70	245.83	245.96	246.09	246.22	246.36	16.80
16.90	246.36	246.49	246.62	246.75	246.88	247.01	247.14	247.28	247.41	247.54	247.67	16.90
17.00	247.67	247.80	247.93	248.06	248.20	248.33	248.46	248.59	248.72	248.85	248.98	17.00
17.10	248.98	249.11	249.25	249.38	249.51	249.64	249.77	249.90	250.03	250.16	250.29	17.10
17.20	250.29	250.43	250.56	250.69	250.82	250.95	251.08	251.21	251.34	251.47	251.61	17.20
17.30	251.61	251.74	251.87	252.00	252.13	252.26	252.39	252.52	252.65	252.79	252.92	17.30
17.40	252.92	253.05	253.18	253.31	253.44	253.57	253.70	253.83	253.96	254.09	254.23	17.40
17.50	254.23	254.36	254.49	254.62	254.75	254.88	255.01	255.14	255.27	255.40	255.53	17.50
17.60	255.53	255.66	255.80	255.93	256.06	256.19	256.32	256.45	256.58	256.71	256.84	17.60
17.70	256.84	256.97	257.10	257.23	257.36	257.50	257.63	257.76	257.89	258.02	258.15	17.70
17.80	258.15	258.28	258.41	258.54	258.67	258.80	258.93	259.06	259.19	259.32	259.45	17.80
17.90	259.45	259.59	259.72	259.85	259.98	260.11	260.24	260.37	260.50	260.63	260.76	17.90
18.00	260.76	260.89	261.02	261.15	261.28	261.41	261.54	261.67	261.80	261.93	262.06	18.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. *Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
18.00	260.76	260.89	261.02	261.15	261.28	261.41	261.54	261.67	261.80	261.93	262.06	18.00
18.10	262.06	262.19	262.33	262.46	262.59	262.72	262.85	262.98	263.11	263.24	263.37	18.10
18.20	263.37	263.50	263.63	263.76	263.89	264.02	264.15	264.28	264.41	264.54	264.67	18.20
18.30	264.67	264.80	264.93	265.06	265.19	265.32	265.45	265.58	265.71	265.84	265.97	18.30
18.40	265.97	266.10	266.23	266.36	266.49	266.62	266.75	266.88	267.01	267.14	267.27	18.40
18.50	267.27	267.40	267.53	267.66	267.79	267.92	268.05	268.18	268.31	268.44	268.57	18.50
18.60	268.57	268.70	268.83	268.96	269.09	269.22	269.35	269.48	269.61	269.74	269.87	18.60
18.70	269.87	270.00	270.13	270.26	270.39	270.52	270.65	270.78	270.91	271.04	271.17	18.70
18.80	271.17	271.30	271.43	271.56	271.69	271.82	271.95	272.08	272.21	272.34	272.47	18.80
18.90	272.47	272.60	272.73	272.86	272.99	273.12	273.25	273.38	273.51	273.64	273.77	18.90
19.00	273.77	273.90	274.03	274.16	274.29	274.42	274.55	274.68	274.81	274.94	275.07	19.00
19.10	275.07	275.20	275.33	275.46	275.58	275.71	275.84	275.97	276.10	276.23	276.36	19.10
19.20	276.36	276.49	276.62	276.75	276.88	277.01	277.14	277.27	277.40	277.53	277.66	19.20
19.30	277.66	277.79	277.92	278.05	278.18	278.31	278.43	278.56	278.69	278.82	278.95	19.30
19.40	278.95	279.08	279.21	279.34	279.47	279.60	279.73	279.86	279.99	280.12	280.25	19.40
19.50	280.25	280.38	280.51	280.63	280.76	280.89	281.02	281.15	281.28	281.41	281.54	19.50
19.60	281.54	281.67	281.80	281.93	282.06	282.19	282.32	282.44	282.57	282.70	282.83	19.60
19.70	282.83	282.96	283.09	283.22	283.35	283.48	283.61	283.74	283.87	283.99	284.12	19.70
19.80	284.12	284.25	284.38	284.51	284.64	284.77	284.90	285.03	285.16	285.29	285.42	19.80
19.90	285.42	285.54	285.67	285.80	285.93	286.06	286.19	286.32	286.45	286.58	286.71	19.90
20.00	286.71	286.83	286.96	287.09	287.22	287.35	287.48	287.61	287.74	287.87	288.00	20.00
20.10	288.00	288.12	288.25	288.38	288.51	288.64	288.77	288.90	289.03	289.16	289.28	20.10
20.20	289.28	289.41	289.54	289.67	289.80	289.93	290.06	290.19	290.32	290.44	290.57	20.20
20.30	290.57	290.70	290.83	290.96	291.09	291.22	291.35	291.47	291.60	291.73	291.86	20.30
20.40	291.86	291.99	292.12	292.25	292.38	292.50	292.63	292.76	292.89	293.02	293.15	20.40
20.50	293.15	293.28	293.41	293.53	293.66	293.79	293.92	294.05	294.18	294.31	294.43	20.50
20.60	294.43	294.56	294.69	294.82	294.95	295.08	295.21	295.34	295.46	295.59	295.72	20.60
20.70	295.72	295.85	295.98	296.11	296.23	296.36	296.49	296.62	296.75	296.88	297.01	20.70
20.80	297.01	297.13	297.26	297.39	297.52	297.65	297.78	297.91	298.03	298.16	298.29	20.80
20.90	298.29	298.42	298.55	298.68	298.80	298.93	299.06	299.19	299.32	299.45	299.57	20.90
21.00	299.57	299.70	299.83	299.96	300.09	300.22	300.34	300.47	300.60	300.73	300.86	21.00
21.10	300.86	300.99	301.11	301.24	301.37	301.50	301.63	301.76	301.88	302.01	302.14	21.10
21.20	302.14	302.27	302.40	302.53	302.65	302.78	302.91	303.04	303.17	303.30	303.42	21.20
21.30	303.42	303.55	303.68	303.81	303.94	304.06	304.19	304.32	304.45	304.58	304.70	21.30
21.40	304.70	304.83	304.96	305.09	305.22	305.35	305.47	305.60	305.73	305.86	305.99	21.40
21.50	305.99	306.11	306.24	306.37	306.50	306.63	306.75	306.88	307.01	307.14	307.27	21.50
21.60	307.27	307.39	307.52	307.65	307.78	307.91	308.03	308.16	308.29	308.42	308.55	21.60
21.70	308.55	308.67	308.80	308.93	309.06	309.19	309.31	309.44	309.57	309.70	309.83	21.70
21.80	309.83	309.95	310.08	310.21	310.34	310.46	310.59	310.72	310.85	310.98	311.10	21.80
21.90	311.10	311.23	311.36	311.49	311.62	311.74	311.87	312.00	312.13	312.25	312.38	21.90
22.00	312.38	312.51	312.64	312.77	312.89	313.02	313.15	313.28	313.40	313.53	313.66	22.00
22.10	313.66	313.79	313.92	314.04	314.17	314.30	314.43	314.55	314.68	314.81	314.94	22.10
22.20	314.94	315.06	315.19	315.32	315.45	315.58	315.70	315.83	315.96	316.09	316.21	22.20
22.30	316.21	316.34	316.47	316.60	316.72	316.85	316.98	317.11	317.23	317.36	317.49	22.30
22.40	317.49	317.62	317.74	317.87	318.00	318.13	318.25	318.38	318.51	318.64	318.76	22.40
22.50	318.76	318.89	319.02	319.15	319.27	319.40	319.53	319.66	319.78	319.91	320.04	22.50
22.60	320.04	320.17	320.29	320.42	320.55	320.68	320.80	320.93	321.06	321.19	321.31	22.60
22.70	321.31	321.44	321.57	321.70	321.82	321.95	322.08	322.21	322.33	322.46	322.59	22.70
22.80	322.59	322.72	322.84	322.97	323.10	323.22	323.35	323.48	323.61	323.73	323.86	22.80
22.90	323.86	323.99	324.12	324.24	324.37	324.50	324.62	324.75	324.88	325.01	325.13	22.90
23.00	325.13	325.26	325.39	325.52	325.64	325.77	325.90	326.02	326.15	326.28	326.41	23.00
23.10	326.41	326.53	326.66	326.79	326.91	327.04	327.17	327.30	327.42	327.55	327.68	23.10
23.20	327.68	327.81	327.93	328.06	328.19	328.31	328.44	328.57	328.69	328.82	328.95	23.20
23.30	328.95	329.08	329.20	329.33	329.46	329.58	329.71	329.84	329.97	330.09	330.22	23.30
23.40	330.22	330.35	330.47	330.60	330.73	330.86	330.98	331.11	331.24	331.36	331.49	23.40
23.50	331.49	331.62	331.74	331.87	332.00	332.13	332.25	332.38	332.51	332.63	332.76	23.50
23.60	332.76	332.89	333.01	333.14	333.27	333.39	333.52	333.65	333.78	333.90	334.03	23.60
23.70	334.03	334.16	334.28	334.41	334.54	334.66	334.79	334.92	335.04	335.17	335.30	23.70
23.80	335.30	335.42	335.55	335.68	335.81	335.93	336.06	336.19	336.31	336.44	336.57	23.80
23.90	336.57	336.69	336.82	336.95	337.07	337.20	337.33	337.45	337.58	337.71	337.83	23.90
24.00	337.83	337.96	338.09	338.21	338.34	338.47	338.59	338.72	338.85	338.97	339.10	24.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
24.00	337.83	337.96	338.09	338.21	338.34	338.47	338.59	338.72	338.85	338.97	339.10	24.00
24.10	339.10	339.23	339.36	339.48	339.61	339.74	339.86	339.99	340.12	340.24	340.37	24.10
24.20	340.37	340.50	340.62	340.75	340.88	341.00	341.13	341.26	341.38	341.51	341.64	24.20
24.30	341.64	341.76	341.89	342.01	342.14	342.27	342.39	342.52	342.65	342.77	342.90	24.30
24.40	342.90	343.03	343.15	343.28	343.41	343.53	343.66	343.79	343.91	344.04	344.17	24.40
24.50	344.17	344.29	344.42	344.55	344.67	344.80	344.93	345.05	345.18	345.31	345.43	24.50
24.60	345.43	345.56	345.68	345.81	345.94	346.06	346.19	346.32	346.44	346.57	346.70	24.60
24.70	346.70	346.82	346.95	347.08	347.20	347.33	347.46	347.58	347.71	347.83	347.96	24.70
24.80	347.96	348.09	348.21	348.34	348.47	348.59	348.72	348.85	348.97	349.10	349.22	24.80
24.90	349.22	349.35	349.48	349.60	349.73	349.86	349.98	350.11	350.24	350.36	350.49	24.90
25.00	350.49	350.61	350.74	350.87	350.99	351.12	351.25	351.37	351.50	351.62	351.75	25.00
25.10	351.75	351.88	352.00	352.13	352.26	352.38	352.51	352.63	352.76	352.89	353.01	25.10
25.20	353.01	353.14	353.27	353.39	353.52	353.64	353.77	353.90	354.02	354.15	354.28	25.20
25.30	354.28	354.40	354.53	354.65	354.78	354.91	355.03	355.16	355.28	355.41	355.54	25.30
25.40	355.54	355.66	355.79	355.92	356.04	356.17	356.29	356.42	356.55	356.67	356.80	25.40
25.50	356.80	356.92	357.05	357.18	357.30	357.43	357.56	357.68	357.81	357.93	358.06	25.50
25.60	358.06	358.19	358.31	358.44	358.56	358.69	358.82	358.94	359.07	359.19	359.32	25.60
25.70	359.32	359.45	359.57	359.70	359.82	359.95	360.08	360.20	360.33	360.45	360.58	25.70
25.80	360.58	360.71	360.83	360.96	361.08	361.21	361.34	361.46	361.59	361.71	361.84	25.80
25.90	361.84	361.97	362.09	362.22	362.34	362.47	362.60	362.72	362.85	362.97	363.10	25.90
26.00	363.10	363.23	363.35	363.48	363.60	363.73	363.85	363.98	364.11	364.23	364.36	26.00
26.10	364.36	364.48	364.61	364.74	364.86	364.99	365.11	365.24	365.36	365.49	365.62	26.10
26.20	365.62	365.74	365.87	365.99	366.12	366.25	366.37	366.50	366.62	366.75	366.87	26.20
26.30	366.87	367.00	367.13	367.25	367.38	367.50	367.63	367.76	367.88	368.01	368.13	26.30
26.40	368.13	368.26	368.38	368.51	368.64	368.76	368.89	369.01	369.14	369.26	369.39	26.40
26.50	369.39	369.52	369.64	369.77	369.89	370.02	370.14	370.27	370.40	370.52	370.65	26.50
26.60	370.65	370.77	370.90	371.02	371.15	371.28	371.40	371.53	371.65	371.78	371.90	26.60
26.70	371.90	372.03	372.15	372.28	372.41	372.53	372.66	372.78	372.91	373.03	373.16	26.70
26.80	373.16	373.29	373.41	373.54	373.66	373.79	373.91	374.04	374.16	374.29	374.42	26.80
26.90	374.42	374.54	374.67	374.79	374.92	375.04	375.17	375.29	375.42	375.55	375.67	26.90
27.00	375.67	375.80	375.92	376.05	376.17	376.30	376.42	376.55	376.68	376.80	376.93	27.00
27.10	376.93	377.05	377.18	377.30	377.43	377.55	377.68	377.81	377.93	378.06	378.18	27.10
27.20	378.18	378.31	378.43	378.56	378.68	378.81	378.93	379.06	379.19	379.31	379.44	27.20
27.30	379.44	379.56	379.69	379.81	379.94	380.06	380.19	380.31	380.44	380.57	380.69	27.30
27.40	380.69	380.82	380.94	381.07	381.19	381.32	381.44	381.57	381.69	381.82	381.94	27.40
27.50	381.94	382.07	382.20	382.32	382.45	382.57	382.70	382.82	382.95	383.07	383.20	27.50
27.60	383.20	383.32	383.45	383.57	383.70	383.82	383.95	384.08	384.20	384.33	384.45	27.60
27.70	384.45	384.58	384.70	384.83	384.95	385.08	385.20	385.33	385.45	385.58	385.70	27.70
27.80	385.70	385.83	385.95	386.08	386.21	386.33	386.46	386.58	386.71	386.83	386.96	27.80
27.90	386.96	387.08	387.21	387.33	387.46	387.58	387.71	387.83	387.96	388.08	388.21	27.90
28.00	388.21	388.33	388.46	388.58	388.71	388.84	388.96	389.09	389.21	389.34	389.46	28.00
28.10	389.46	389.59	389.71	389.84	389.96	390.09	390.21	390.34	390.46	390.59	390.71	28.10
28.20	390.71	390.84	390.96	391.09	391.21	391.34	391.46	391.59	391.71	391.84	391.96	28.20
28.30	391.96	392.09	392.21	392.34	392.46	392.59	392.71	392.84	392.97	393.09	393.22	28.30
28.40	393.22	393.34	393.47	393.59	393.72	393.84	393.97	394.09	394.22	394.34	394.47	28.40
28.50	394.47	394.59	394.72	394.84	394.97	395.09	395.22	395.34	395.47	395.59	395.72	28.50
28.60	395.72	395.84	395.97	396.09	396.22	396.34	396.47	396.59	396.72	396.84	396.97	28.60
28.70	396.97	397.09	397.22	397.34	397.47	397.59	397.72	397.84	397.97	398.09	398.22	28.70
28.80	398.22	398.34	398.47	398.59	398.72	398.84	398.97	399.09	399.22	399.34	399.47	28.80
28.90	399.47	399.59	399.72	399.84	399.97	400.09	400.22	400.34	400.47	400.59	400.72	28.90
29.00	400.72	400.84	400.97	401.09	401.22	401.34	401.47	401.59	401.71	401.84	401.96	29.00
29.10	401.96	402.09	402.21	402.34	402.46	402.59	402.71	402.84	402.96	403.09	403.21	29.10
29.20	403.21	403.34	403.46	403.59	403.71	403.84	403.96	404.09	404.21	404.34	404.46	29.20
29.30	404.46	404.59	404.71	404.84	404.96	405.09	405.21	405.34	405.46	405.59	405.71	29.30
29.40	405.71	405.83	405.96	406.08	406.21	406.33	406.46	406.58	406.71	406.83	406.96	29.40
29.50	406.96	407.08	407.21	407.33	407.46	407.58	407.71	407.83	407.96	408.08	408.21	29.50
29.60	408.21	408.33	408.46	408.58	408.70	408.83	408.95	409.08	409.20	409.33	409.45	29.60
29.70	409.45	409.58	409.70	409.83	409.95	410.08	410.20	410.33	410.45	410.58	410.70	29.70
29.80	410.70	410.82	410.95	411.07	411.20	411.32	411.45	411.57	411.70	411.82	411.95	29.80
29.90	411.95	412.07	412.20	412.32	412.45	412.57	412.70	412.82	412.94	413.07	413.19	29.90
30.00	413.19	413.32	413.44	413.57	413.69	413.82	413.94	414.07	414.19	414.32	414.44	30.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. *Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
30.00	413.19	413.32	413.44	413.57	413.69	413.82	413.94	414.07	414.19	414.32	414.44	30.00
30.10	414.44	414.56	414.69	414.81	414.94	415.06	415.19	415.31	415.44	415.56	415.69	30.10
30.20	415.69	415.81	415.94	416.06	416.18	416.31	416.43	416.56	416.68	416.81	416.93	30.20
30.30	416.93	417.06	417.18	417.31	417.43	417.56	417.68	417.80	417.93	418.05	418.18	30.30
30.40	418.18	418.30	418.43	418.55	418.68	418.80	418.93	419.05	419.17	419.30	419.42	30.40
30.50	419.42	419.55	419.67	419.80	419.92	420.05	420.17	420.30	420.42	420.54	420.67	30.50
30.60	420.67	420.79	420.92	421.04	421.17	421.29	421.42	421.54	421.66	421.79	421.91	30.60
30.70	421.91	422.04	422.16	422.29	422.41	422.54	422.66	422.78	422.91	423.03	423.16	30.70
30.80	423.16	423.28	423.41	423.53	423.66	423.78	423.91	424.03	424.15	424.28	424.40	30.80
30.90	424.40	424.53	424.65	424.78	424.90	425.03	425.15	425.27	425.40	425.52	425.65	30.90
31.00	425.65	425.77	425.90	426.02	426.14	426.27	426.39	426.52	426.64	426.77	426.89	31.00
31.10	426.89	427.02	427.14	427.26	427.39	427.51	427.64	427.76	427.89	428.01	428.14	31.10
31.20	428.14	428.26	428.38	428.51	428.63	428.76	428.88	429.01	429.13	429.25	429.38	31.20
31.30	429.38	429.50	429.63	429.75	429.88	430.00	430.12	430.25	430.37	430.50	430.62	31.30
31.40	430.62	430.75	430.87	431.00	431.12	431.24	431.37	431.49	431.62	431.74	431.87	31.40
31.50	431.87	431.99	432.11	432.24	432.36	432.49	432.61	432.74	432.86	432.98	433.11	31.50
31.60	433.11	433.23	433.36	433.48	433.61	433.73	433.85	433.98	434.10	434.23	434.35	31.60
31.70	434.35	434.48	434.60	434.72	434.85	434.97	435.10	435.22	435.35	435.47	435.59	31.70
31.80	435.59	435.72	435.84	435.97	436.09	436.22	436.34	436.46	436.59	436.71	436.84	31.80
31.90	436.84	436.96	437.09	437.21	437.33	437.46	437.58	437.71	437.83	437.95	438.08	31.90
32.00	438.08	438.20	438.33	438.45	438.58	438.70	438.82	438.95	439.07	439.20	439.32	32.00
32.10	439.32	439.45	439.57	439.69	439.82	439.94	440.07	440.19	440.31	440.44	440.56	32.10
32.20	440.56	440.69	440.81	440.94	441.06	441.18	441.31	441.43	441.56	441.68	441.80	32.20
32.30	441.80	441.93	442.05	442.18	442.30	442.43	442.55	442.67	442.80	442.92	443.05	32.30
32.40	443.05	443.17	443.29	443.42	443.54	443.67	443.79	443.92	444.04	444.16	444.29	32.40
32.50	444.29	444.41	444.54	444.66	444.78	444.91	445.03	445.16	445.28	445.40	445.53	32.50
32.60	445.53	445.65	445.78	445.90	446.03	446.15	446.27	446.40	446.52	446.65	446.77	32.60
32.70	446.77	446.89	447.02	447.14	447.27	447.39	447.51	447.64	447.76	447.89	448.01	32.70
32.80	448.01	448.13	448.26	448.38	448.51	448.63	448.76	448.88	449.00	449.13	449.25	32.80
32.90	449.25	449.38	449.50	449.62	449.75	449.87	450.00	450.12	450.24	450.37	450.49	32.90
33.00	450.49	450.62	450.74	450.86	450.99	451.11	451.24	451.36	451.48	451.61	451.73	33.00
33.10	451.73	451.86	451.98	452.10	452.23	452.35	452.48	452.60	452.72	452.85	452.97	33.10
33.20	452.97	453.10	453.22	453.34	453.47	453.59	453.72	453.84	453.96	454.09	454.21	33.20
33.30	454.21	454.34	454.46	454.58	454.71	454.83	454.96	455.08	455.20	455.33	455.45	33.30
33.40	455.45	455.58	455.70	455.82	455.95	456.07	456.20	456.32	456.44	456.57	456.69	33.40
33.50	456.69	456.82	456.94	457.06	457.19	457.31	457.44	457.56	457.68	457.81	457.93	33.50
33.60	457.93	458.06	458.18	458.30	458.43	458.55	458.68	458.80	458.92	459.05	459.17	33.60
33.70	459.17	459.30	459.42	459.54	459.67	459.79	459.91	460.04	460.16	460.29	460.41	33.70
33.80	460.41	460.53	460.66	460.78	460.91	461.03	461.15	461.28	461.40	461.53	461.65	33.80
33.90	461.65	461.77	461.90	462.02	462.15	462.27	462.39	462.52	462.64	462.77	462.89	33.90
34.00	462.89	463.01	463.14	463.26	463.38	463.51	463.63	463.76	463.88	464.00	464.13	34.00
34.10	464.13	464.25	464.38	464.50	464.62	464.75	464.87	465.00	465.12	465.24	465.37	34.10
34.20	465.37	465.49	465.61	465.74	465.86	465.99	466.11	466.23	466.36	466.48	466.61	34.20
34.30	466.61	466.73	466.85	466.98	467.10	467.22	467.35	467.47	467.60	467.72	467.84	34.30
34.40	467.84	467.97	468.09	468.22	468.34	468.46	468.59	468.71	468.83	468.96	469.08	34.40
34.50	469.08	469.21	469.33	469.45	469.58	469.70	469.83	469.95	470.07	470.20	470.32	34.50
34.60	470.32	470.44	470.57	470.69	470.82	470.94	471.06	471.19	471.31	471.44	471.56	34.60
34.70	471.56	471.68	471.81	471.93	472.05	472.18	472.30	472.43	472.55	472.67	472.80	34.70
34.80	472.80	472.92	473.04	473.17	473.29	473.42	473.54	473.66	473.79	473.91	474.04	34.80
34.90	474.04	474.16	474.28	474.41	474.53	474.65	474.78	474.90	475.03	475.15	475.27	34.90
35.00	475.27	475.40	475.52	475.64	475.77	475.89	476.02	476.14	476.26	476.39	476.51	35.00
35.10	476.51	476.63	476.76	476.88	477.01	477.13	477.25	477.38	477.50	477.62	477.75	35.10
35.20	477.75	477.87	478.00	478.12	478.24	478.37	478.49	478.61	478.74	478.86	478.99	35.20
35.30	478.99	479.11	479.23	479.36	479.48	479.60	479.73	479.85	479.98	480.10	480.22	35.30
35.40	480.22	480.35	480.47	480.59	480.72	480.84	480.97	481.09	481.21	481.34	481.46	35.40
35.50	481.46	481.58	481.71	481.83	481.96	482.08	482.20	482.33	482.45	482.57	482.70	35.50
35.60	482.70	482.82	482.95	483.07	483.19	483.32	483.44	483.56	483.69	483.81	483.94	35.60
35.70	483.94	484.06	484.18	484.31	484.43	484.55	484.68	484.80	484.93	485.05	485.17	35.70
35.80	485.17	485.30	485.42	485.54	485.67	485.79	485.91	486.04	486.16	486.29	486.41	35.80
35.90	486.41	486.53	486.66	486.78	486.90	487.03	487.15	487.28	487.40	487.52	487.65	35.90
36.00	487.65	487.77	487.89	488.02	488.14	488.27	488.39	488.51	488.64	488.76	488.88	36.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
36.00	487.65	487.77	487.89	488.02	488.14	488.27	488.39	488.51	488.64	488.76	488.88	36.00
36.10	488.88	489.01	489.13	489.25	489.38	489.50	489.63	489.75	489.87	490.00	490.12	36.10
36.20	490.12	490.24	490.37	490.49	490.62	490.74	490.86	490.99	491.11	491.23	491.36	36.20
36.30	491.36	491.48	491.60	491.73	491.85	491.98	492.10	492.22	492.35	492.47	492.59	36.30
36.40	492.59	492.72	492.84	492.96	493.09	493.21	493.34	493.46	493.58	493.71	493.83	36.40
36.50	493.83	493.95	494.08	494.20	494.33	494.45	494.57	494.70	494.82	494.94	495.07	36.50
36.60	495.07	495.19	495.31	495.44	495.56	495.69	495.81	495.93	496.06	496.18	496.30	36.60
36.70	496.30	496.43	496.55	496.67	496.80	496.92	497.05	497.17	497.29	497.42	497.54	36.70
36.80	497.54	497.66	497.79	497.91	498.03	498.16	498.28	498.41	498.53	498.65	498.78	36.80
36.90	498.78	498.90	499.02	499.15	499.27	499.39	499.52	499.64	499.77	499.89	500.01	36.90
37.00	500.01	500.14	500.26	500.38	500.51	500.63	500.75	500.88	501.00	501.13	501.25	37.00
37.10	501.25	501.37	501.50	501.62	501.74	501.87	501.99	502.11	502.24	502.36	502.49	37.10
37.20	502.49	502.61	502.73	502.86	502.98	503.10	503.23	503.35	503.47	503.60	503.72	37.20
37.30	503.72	503.84	503.97	504.09	504.22	504.34	504.46	504.59	504.71	504.83	504.96	37.30
37.40	504.96	505.08	505.20	505.33	505.45	505.58	505.70	505.82	505.95	506.07	506.19	37.40
37.50	506.19	506.32	506.44	506.56	506.69	506.81	506.94	507.06	507.18	507.31	507.43	37.50
37.60	507.43	507.55	507.68	507.80	507.92	508.05	508.17	508.29	508.42	508.54	508.67	37.60
37.70	508.67	508.79	508.91	509.04	509.16	509.28	509.41	509.53	509.65	509.78	509.90	37.70
37.80	509.90	510.03	510.15	510.27	510.40	510.52	510.64	510.77	510.89	511.01	511.14	37.80
37.90	511.14	511.26	511.38	511.51	511.63	511.76	511.88	512.00	512.13	512.25	512.37	37.90
38.00	512.37	512.50	512.62	512.74	512.87	512.99	513.12	513.24	513.36	513.49	513.61	38.00
38.10	513.61	513.73	513.86	513.98	514.10	514.23	514.35	514.47	514.60	514.72	514.85	38.10
38.20	514.85	514.97	515.09	515.22	515.34	515.46	515.59	515.71	515.83	515.96	516.08	38.20
38.30	516.08	516.20	516.33	516.45	516.58	516.70	516.82	516.95	517.07	517.19	517.32	38.30
38.40	517.32	517.44	517.56	517.69	517.81	517.93	518.06	518.18	518.31	518.43	518.55	38.40
38.50	518.55	518.68	518.80	518.92	519.05	519.17	519.29	519.42	519.54	519.66	519.79	38.50
38.60	519.79	519.91	520.04	520.16	520.28	520.41	520.53	520.65	520.78	520.90	521.02	38.60
38.70	521.02	521.15	521.27	521.40	521.52	521.64	521.77	521.89	522.01	522.14	522.26	38.70
38.80	522.26	522.38	522.51	522.63	522.75	522.88	523.00	523.13	523.25	523.37	523.50	38.80
38.90	523.50	523.62	523.74	523.87	523.99	524.11	524.24	524.36	524.48	524.61	524.73	38.90
39.00	524.73	524.86	524.98	525.10	525.23	525.35	525.47	525.60	525.72	525.84	525.97	39.00
39.10	525.97	526.09	526.21	526.34	526.46	526.59	526.71	526.83	526.96	527.08	527.20	39.10
39.20	527.20	527.33	527.45	527.57	527.70	527.82	527.94	528.07	528.19	528.32	528.44	39.20
39.30	528.44	528.56	528.69	528.81	528.93	529.06	529.18	529.30	529.43	529.55	529.67	39.30
39.40	529.67	529.80	529.92	530.05	530.17	530.29	530.42	530.54	530.66	530.79	530.91	39.40
39.50	530.91	531.03	531.16	531.28	531.40	531.53	531.65	531.78	531.90	532.02	532.15	39.50
39.60	532.15	532.27	532.39	532.52	532.64	532.76	532.89	533.01	533.13	533.26	533.38	39.60
39.70	533.38	533.51	533.63	533.75	533.88	534.00	534.12	534.25	534.37	534.49	534.62	39.70
39.80	534.62	534.74	534.86	534.99	535.11	535.24	535.36	535.48	535.61	535.73	535.85	39.80
39.90	535.85	535.98	536.10	536.22	536.35	536.47	536.60	536.72	536.84	536.97	537.09	39.90
40.00	537.09	537.21	537.34	537.46	537.58	537.71	537.83	537.95	538.08	538.20	538.33	40.00
40.10	538.33	538.45	538.57	538.70	538.82	538.94	539.07	539.19	539.31	539.44	539.56	40.10
40.20	539.56	539.68	539.81	539.93	540.06	540.18	540.30	540.43	540.55	540.67	540.80	40.20
40.30	540.80	540.92	541.04	541.17	541.29	541.41	541.54	541.66	541.79	541.91	542.03	40.30
40.40	542.03	542.16	542.28	542.40	542.53	542.65	542.77	542.90	543.02	543.15	543.27	40.40
40.50	543.27	543.39	543.52	543.64	543.76	543.89	544.01	544.13	544.26	544.38	544.50	40.50
40.60	544.50	544.63	544.75	544.88	545.00	545.12	545.25	545.37	545.49	545.62	545.74	40.60
40.70	545.74	545.86	545.99	546.11	546.24	546.36	546.48	546.61	546.73	546.85	546.98	40.70
40.80	546.98	547.10	547.22	547.35	547.47	547.59	547.72	547.84	547.97	548.09	548.21	40.80
40.90	548.21	548.34	548.46	548.58	548.71	548.83	548.95	549.08	549.20	549.33	549.45	40.90
41.00	549.45	549.57	549.70	549.82	549.94	550.07	550.19	550.31	550.44	550.56	550.69	41.00
41.10	550.69	550.81	550.93	551.06	551.18	551.30	551.43	551.55	551.67	551.80	551.92	41.10
41.20	551.92	552.05	552.17	552.29	552.42	552.54	552.66	552.79	552.91	553.03	553.16	41.20
41.30	553.16	553.28	553.41	553.53	553.65	553.78	553.90	554.02	554.15	554.27	554.39	41.30
41.40	554.39	554.52	554.64	554.76	554.89	555.01	555.14	555.26	555.38	555.51	555.63	41.40
41.50	555.63	555.75	555.88	556.00	556.12	556.25	556.37	556.50	556.62	556.74	556.87	41.50
41.60	556.87	556.99	557.11	557.24	557.36	557.49	557.61	557.73	557.86	557.98	558.10	41.60
41.70	558.10	558.23	558.35	558.47	558.60	558.72	558.85	558.97	559.09	559.22	559.34	41.70
41.80	559.34	559.46	559.59	559.71	559.83	559.96	560.08	560.21	560.33	560.45	560.58	41.80
41.90	560.58	560.70	560.82	560.95	561.07	561.19	561.32	561.44	561.57	561.69	561.81	41.90
42.00	561.81	561.94	562.06	562.18	562.31	562.43	562.56	562.68	562.80	562.93	563.05	42.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. *Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
42.00	561.81	561.94	562.06	562.18	562.31	562.43	562.56	562.68	562.80	562.93	563.05	42.00
42.10	563.05	563.17	563.30	563.42	563.54	563.67	563.79	563.92	564.04	564.16	564.29	42.10
42.20	564.29	564.41	564.53	564.66	564.78	564.90	565.03	565.15	565.28	565.40	565.52	42.20
42.30	565.52	565.65	565.77	565.89	566.02	566.14	566.27	566.39	566.51	566.64	566.76	42.30
42.40	566.76	566.88	567.01	567.13	567.26	567.38	567.50	567.63	567.75	567.87	568.00	42.40
42.50	568.00	568.12	568.24	568.37	568.49	568.62	568.74	568.86	568.99	569.11	569.23	42.50
42.60	569.23	569.36	569.48	569.61	569.73	569.85	569.98	570.10	570.22	570.35	570.47	42.60
42.70	570.47	570.60	570.72	570.84	570.97	571.09	571.21	571.34	571.46	571.58	571.71	42.70
42.80	571.71	571.83	571.96	572.08	572.20	572.33	572.45	572.57	572.70	572.82	572.95	42.80
42.90	572.95	573.07	573.19	573.32	573.44	573.56	573.69	573.81	573.94	574.06	574.18	42.90
43.00	574.18	574.31	574.43	574.55	574.68	574.80	574.93	575.05	575.17	575.30	575.42	43.00
43.10	575.42	575.54	575.67	575.79	575.92	576.04	576.16	576.29	576.41	576.53	576.66	43.10
43.20	576.66	576.78	576.91	577.03	577.15	577.28	577.40	577.52	577.65	577.77	577.90	43.20
43.30	577.90	578.02	578.14	578.27	578.39	578.51	578.64	578.76	578.89	579.01	579.13	43.30
43.40	579.13	579.26	579.38	579.50	579.63	579.75	579.88	580.00	580.12	580.25	580.37	43.40
43.50	580.37	580.50	580.62	580.74	580.87	580.99	581.11	581.24	581.36	581.49	581.61	43.50
43.60	581.61	581.73	581.86	581.98	582.10	582.23	582.35	582.48	582.60	582.72	582.85	43.60
43.70	582.85	582.97	583.09	583.22	583.34	583.47	583.59	583.71	583.84	583.96	584.09	43.70
43.80	584.09	584.21	584.33	584.46	584.58	584.70	584.83	584.95	585.08	585.20	585.32	43.80
43.90	585.32	585.45	585.57	585.69	585.82	585.94	586.07	586.19	586.31	586.44	586.56	43.90
44.00	586.56	586.69	586.81	586.93	587.06	587.18	587.30	587.43	587.55	587.68	587.80	44.00
44.10	587.80	587.92	588.05	588.17	588.30	588.42	588.54	588.67	588.79	588.91	589.04	44.10
44.20	589.04	589.16	589.29	589.41	589.53	589.66	589.78	589.91	590.03	590.15	590.28	44.20
44.30	590.28	590.40	590.52	590.65	590.77	590.90	591.02	591.14	591.27	591.39	591.52	44.30
44.40	591.52	591.64	591.76	591.89	592.01	592.14	592.26	592.38	592.51	592.63	592.75	44.40
44.50	592.75	592.88	593.00	593.13	593.25	593.37	593.50	593.62	593.75	593.87	593.99	44.50
44.60	593.99	594.12	594.24	594.37	594.49	594.61	594.74	594.86	594.98	595.11	595.23	44.60
44.70	595.23	595.36	595.48	595.60	595.73	595.85	595.98	596.10	596.22	596.35	596.47	44.70
44.80	596.47	596.60	596.72	596.84	596.97	597.09	597.22	597.34	597.46	597.59	597.71	44.80
44.90	597.71	597.83	597.96	598.08	598.21	598.33	598.45	598.58	598.70	598.83	598.95	44.90
45.00	598.95	599.07	599.20	599.32	599.45	599.57	599.69	599.82	599.94	600.07	600.19	45.00
45.10	600.19	600.31	600.44	600.56	600.69	600.81	600.93	601.06	601.18	601.31	601.43	45.10
45.20	601.43	601.55	601.68	601.80	601.93	602.05	602.17	602.30	602.42	602.55	602.67	45.20
45.30	602.67	602.79	602.92	603.04	603.17	603.29	603.41	603.54	603.66	603.78	603.91	45.30
45.40	603.91	604.03	604.16	604.28	604.40	604.53	604.65	604.78	604.90	605.02	605.15	45.40
45.50	605.15	605.27	605.40	605.52	605.64	605.77	605.89	606.02	606.14	606.27	606.39	45.50
45.60	606.39	606.51	606.64	606.76	606.89	607.01	607.13	607.26	607.38	607.51	607.63	45.60
45.70	607.63	607.75	607.88	608.00	608.13	608.25	608.37	608.50	608.62	608.75	608.87	45.70
45.80	608.87	608.99	609.12	609.24	609.37	609.49	609.61	609.74	609.86	609.99	610.11	45.80
45.90	610.11	610.23	610.36	610.48	610.61	610.73	610.85	610.98	611.10	611.23	611.35	45.90
46.00	611.35	611.47	611.60	611.72	611.85	611.97	612.10	612.22	612.34	612.47	612.59	46.00
46.10	612.59	612.72	612.84	612.96	613.09	613.21	613.34	613.46	613.58	613.71	613.83	46.10
46.20	613.83	613.96	614.08	614.20	614.33	614.45	614.58	614.70	614.83	614.95	615.07	46.20
46.30	615.07	615.20	615.32	615.45	615.57	615.69	615.82	615.94	616.07	616.19	616.31	46.30
46.40	616.31	616.44	616.56	616.69	616.81	616.94	617.06	617.18	617.31	617.43	617.56	46.40
46.50	617.56	617.68	617.80	617.93	618.05	618.18	618.30	618.43	618.55	618.67	618.80	46.50
46.60	618.80	618.92	619.05	619.17	619.29	619.42	619.54	619.67	619.79	619.92	620.04	46.60
46.70	620.04	620.16	620.29	620.41	620.54	620.66	620.78	620.91	621.03	621.16	621.28	46.70
46.80	621.28	621.41	621.53	621.65	621.78	621.90	622.03	622.15	622.27	622.40	622.52	46.80
46.90	622.52	622.65	622.77	622.90	623.02	623.14	623.27	623.39	623.52	623.64	623.76	46.90
47.00	623.76	623.89	624.01	624.14	624.26	624.39	624.51	624.63	624.76	624.88	625.01	47.00
47.10	625.01	625.13	625.26	625.38	625.50	625.63	625.75	625.88	626.00	626.13	626.25	47.10
47.20	626.25	626.37	626.50	626.62	626.75	626.87	627.00	627.12	627.24	627.37	627.49	47.20
47.30	627.49	627.62	627.74	627.86	627.99	628.11	628.24	628.36	628.49	628.61	628.73	47.30
47.40	628.73	628.86	628.98	629.11	629.23	629.36	629.48	629.60	629.73	629.85	629.98	47.40
47.50	629.98	630.10	630.23	630.35	630.47	630.60	630.72	630.85	630.97	631.10	631.22	47.50
47.60	631.22	631.34	631.47	631.59	631.72	631.84	631.97	632.09	632.22	632.34	632.46	47.60
47.70	632.46	632.59	632.71	632.84	632.96	633.09	633.21	633.33	633.46	633.58	633.71	47.70
47.80	633.71	633.83	633.96	634.08	634.20	634.33	634.45	634.58	634.70	634.83	634.95	47.80
47.90	634.95	635.08	635.20	635.32	635.45	635.57	635.70	635.82	635.95	636.07	636.19	47.90
48.00	636.19	636.32	636.44	636.57	636.69	636.82	636.94	637.07	637.19	637.31	637.44	48.00

TABLE A5.2.1. *Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
48.00	636.19	636.32	636.44	636.57	636.69	636.82	636.94	637.07	637.19	637.31	637.44	48.00
48.10	637.44	637.56	637.69	637.81	637.94	638.06	638.18	638.31	638.43	638.56	638.68	48.10
48.20	638.68	638.81	638.93	639.06	639.18	639.30	639.43	639.55	639.68	639.80	639.93	48.20
48.30	639.93	640.05	640.18	640.30	640.42	640.55	640.67	640.80	640.92	641.05	641.17	48.30
48.40	641.17	641.30	641.42	641.54	641.67	641.79	641.92	642.04	642.17	642.29	642.42	48.40
48.50	642.42	642.54	642.66	642.79	642.91	643.04	643.16	643.29	643.41	643.54	643.66	48.50
48.60	643.66	643.78	643.91	644.03	644.16	644.28	644.41	644.53	644.66	644.78	644.90	48.60
48.70	644.90	645.03	645.15	645.28	645.40	645.53	645.65	645.78	645.90	646.03	646.15	48.70
48.80	646.15	646.27	646.40	646.52	646.65	646.77	646.90	647.02	647.15	647.27	647.39	48.80
48.90	647.39	647.52	647.64	647.77	647.89	648.02	648.14	648.27	648.39	648.52	648.64	48.90
49.00	648.64	648.76	648.89	649.01	649.14	649.26	649.39	649.51	649.64	649.76	649.89	49.00
49.10	649.89	650.01	650.14	650.26	650.38	650.51	650.63	650.76	650.88	651.01	651.13	49.10
49.20	651.13	651.26	651.38	651.51	651.63	651.75	651.88	652.00	652.13	652.25	652.38	49.20
49.30	652.38	652.50	652.63	652.75	652.88	653.00	653.13	653.25	653.37	653.50	653.62	49.30
49.40	653.62	653.75	653.87	654.00	654.12	654.25	654.37	654.50	654.62	654.75	654.87	49.40
49.50	654.87	654.99	655.12	655.24	655.37	655.49	655.62	655.74	655.87	655.99	656.12	49.50
49.60	656.12	656.24	656.37	656.49	656.62	656.74	656.86	656.99	657.11	657.24	657.36	49.60
49.70	657.36	657.49	657.61	657.74	657.86	657.99	658.11	658.24	658.36	658.49	658.61	49.70
49.80	658.61	658.73	658.86	658.98	659.11	659.23	659.36	659.48	659.61	659.73	659.86	49.80
49.90	659.86	659.98	660.11	660.23	660.36	660.48	660.61	660.73	660.85	660.98	661.10	49.90
50.00	661.10	661.23	661.35	661.48	661.60	661.73	661.85	661.98	662.10	662.23	662.35	50.00
50.10	662.35	662.48	662.60	662.73	662.85	662.98	663.10	663.23	663.35	663.47	663.60	50.10
50.20	663.60	663.72	663.85	663.97	664.10	664.22	664.35	664.47	664.60	664.72	664.85	50.20
50.30	664.85	664.97	665.10	665.22	665.35	665.47	665.60	665.72	665.85	665.97	666.10	50.30
50.40	666.10	666.22	666.35	666.47	666.59	666.72	666.84	666.97	667.09	667.22	667.34	50.40
50.50	667.34	667.47	667.59	667.72	667.84	667.97	668.09	668.22	668.34	668.47	668.59	50.50
50.60	668.59	668.72	668.84	668.97	669.09	669.22	669.34	669.47	669.59	669.72	669.84	50.60
50.70	669.84	669.97	670.09	670.22	670.34	670.47	670.59	670.71	670.84	670.96	671.09	50.70
50.80	671.09	671.21	671.34	671.46	671.59	671.71	671.84	671.96	672.09	672.21	672.34	50.80
50.90	672.34	672.46	672.59	672.71	672.84	672.96	673.09	673.21	673.34	673.46	673.59	50.90
51.00	673.59	673.71	673.84	673.96	674.09	674.21	674.34	674.46	674.59	674.71	674.84	51.00
51.10	674.84	674.96	675.09	675.21	675.34	675.46	675.59	675.71	675.84	675.96	676.09	51.10
51.20	676.09	676.21	676.34	676.46	676.59	676.71	676.84	676.96	677.09	677.21	677.34	51.20
51.30	677.34	677.46	677.59	677.71	677.84	677.96	678.09	678.21	678.34	678.46	678.59	51.30
51.40	678.59	678.71	678.84	678.96	679.09	679.21	679.34	679.46	679.59	679.71	679.84	51.40
51.50	679.84	679.96	680.09	680.21	680.34	680.46	680.59	680.71	680.84	680.96	681.09	51.50
51.60	681.09	681.21	681.34	681.46	681.59	681.71	681.84	681.96	682.09	682.21	682.34	51.60
51.70	682.34	682.46	682.59	682.71	682.84	682.96	683.09	683.21	683.34	683.46	683.59	51.70
51.80	683.59	683.71	683.84	683.96	684.09	684.21	684.34	684.46	684.59	684.72	684.84	51.80
51.90	684.84	684.97	685.09	685.22	685.34	685.47	685.59	685.72	685.84	685.97	686.09	51.90
52.00	686.09	686.22	686.34	686.47	686.59	686.72	686.84	686.97	687.09	687.22	687.34	52.00
52.10	687.34	687.47	687.59	687.72	687.84	687.97	688.09	688.22	688.34	688.47	688.59	52.10
52.20	688.59	688.72	688.85	688.97	689.10	689.22	689.35	689.47	689.60	689.72	689.85	52.20
52.30	689.85	689.97	690.10	690.22	690.35	690.47	690.60	690.72	690.85	690.97	691.10	52.30
52.40	691.10	691.22	691.35	691.47	691.60	691.73	691.85	691.98	692.10	692.23	692.35	52.40
52.50	692.35	692.48	692.60	692.73	692.85	692.98	693.10	693.23	693.35	693.48	693.60	52.50
52.60	693.60	693.73	693.85	693.98	694.11	694.23	694.36	694.48	694.61	694.73	694.86	52.60
52.70	694.86	694.98	695.11	695.23	695.36	695.48	695.61	695.73	695.86	695.98	696.11	52.70
52.80	696.11	696.24	696.36	696.49	696.61	696.74	696.86	696.99	697.11	697.24	697.36	52.80
52.90	697.36	697.49	697.61	697.74	697.86	697.99	698.12	698.24	698.37	698.49	698.62	52.90
53.00	698.62	698.74	698.87	698.99	699.12	699.24	699.37	699.49	699.62	699.75	699.87	53.00
53.10	699.87	700.00	700.12	700.25	700.37	700.50	700.62	700.75	700.87	701.00	701.12	53.10
53.20	701.12	701.25	701.38	701.50	701.63	701.75	701.88	702.00	702.13	702.25	702.38	53.20
53.30	702.38	702.50	702.63	702.76	702.88	703.01	703.13	703.26	703.38	703.51	703.63	53.30
53.40	703.63	703.76	703.88	704.01	704.14	704.26	704.39	704.51	704.64	704.76	704.89	53.40
53.50	704.89	705.01	705.14	705.26	705.39	705.52	705.64	705.77	705.89	706.02	706.14	53.50
53.60	706.14	706.27	706.39	706.52	706.65	706.77	706.90	707.02	707.15	707.27	707.40	53.60
53.70	707.40	707.52	707.65	707.77	707.90	708.03	708.15	708.28	708.40	708.53	708.65	53.70
53.80	708.65	708.78	708.90	709.03	709.16	709.28	709.41	709.53	709.66	709.78	709.91	53.80
53.90	709.91	710.03	710.16	710.29	710.41	710.54	710.66	710.79	710.91	711.04	711.16	53.90
54.00	711.16	711.29	711.42	711.54	711.67	711.79	711.92	712.04	712.17	712.30	712.42	54.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
54.00	711.16	711.29	711.42	711.54	711.67	711.79	711.92	712.04	712.17	712.30	712.42	54.00
54.10	712.42	712.55	712.67	712.80	712.92	713.05	713.17	713.30	713.43	713.55	713.68	54.10
54.20	713.68	713.80	713.93	714.05	714.18	714.31	714.43	714.56	714.68	714.81	714.93	54.20
54.30	714.93	715.06	715.19	715.31	715.44	715.56	715.69	715.81	715.94	716.07	716.19	54.30
54.40	716.19	716.32	716.44	716.57	716.69	716.82	716.94	717.07	717.20	717.32	717.45	54.40
54.50	717.45	717.57	717.70	717.82	717.95	718.08	718.20	718.33	718.45	718.58	718.70	54.50
54.60	718.70	718.83	718.96	719.08	719.21	719.33	719.46	719.59	719.71	719.84	719.96	54.60
54.70	719.96	720.09	720.21	720.34	720.47	720.59	720.72	720.84	720.97	721.09	721.22	54.70
54.80	721.22	721.35	721.47	721.60	721.72	721.85	721.98	722.10	722.23	722.35	722.48	54.80
54.90	722.48	722.60	722.73	722.86	722.98	723.11	723.23	723.36	723.48	723.61	723.74	54.90
55.00	723.74	723.86	723.99	724.11	724.24	724.37	724.49	724.62	724.74	724.87	725.00	55.00
55.10	725.00	725.12	725.25	725.37	725.50	725.62	725.75	725.88	726.00	726.13	726.25	55.10
55.20	726.25	726.38	726.51	726.63	726.76	726.88	727.01	727.14	727.26	727.39	727.51	55.20
55.30	727.51	727.64	727.76	727.89	728.02	728.14	728.27	728.39	728.52	728.65	728.77	55.30
55.40	728.77	728.90	729.02	729.15	729.28	729.40	729.53	729.65	729.78	729.91	730.03	55.40
55.50	730.03	730.16	730.28	730.41	730.54	730.66	730.79	730.91	731.04	731.17	731.29	55.50
55.60	731.29	731.42	731.54	731.67	731.80	731.92	732.05	732.17	732.30	732.43	732.55	55.60
55.70	732.55	732.68	732.80	732.93	733.06	733.18	733.31	733.43	733.56	733.69	733.81	55.70
55.80	733.81	733.94	734.06	734.19	734.32	734.44	734.57	734.69	734.82	734.95	735.07	55.80
55.90	735.07	735.20	735.32	735.45	735.58	735.70	735.83	735.95	736.08	736.21	736.33	55.90
56.00	736.33	736.46	736.58	736.71	736.84	736.96	737.09	737.22	737.34	737.47	737.59	56.00
56.10	737.59	737.72	737.85	737.97	738.10	738.22	738.35	738.48	738.60	738.73	738.85	56.10
56.20	738.85	738.98	739.11	739.23	739.36	739.49	739.61	739.74	739.86	739.99	740.12	56.20
56.30	740.12	740.24	740.37	740.49	740.62	740.75	740.87	741.00	741.13	741.25	741.38	56.30
56.40	741.38	741.50	741.63	741.76	741.88	742.01	742.14	742.26	742.39	742.51	742.64	56.40
56.50	742.64	742.77	742.89	743.02	743.15	743.27	743.40	743.52	743.65	743.78	743.90	56.50
56.60	743.90	744.03	744.15	744.28	744.41	744.53	744.66	744.79	744.91	745.04	745.17	56.60
56.70	745.17	745.29	745.42	745.54	745.67	745.80	745.92	746.05	746.18	746.30	746.43	56.70
56.80	746.43	746.55	746.68	746.81	746.93	747.06	747.19	747.31	747.44	747.56	747.69	56.80
56.90	747.69	747.82	747.94	748.07	748.20	748.32	748.45	748.58	748.70	748.83	748.95	56.90
57.00	748.95	749.08	749.21	749.33	749.46	749.59	749.71	749.84	749.97	750.09	750.22	57.00
57.10	750.22	750.34	750.47	750.60	750.72	750.85	750.98	751.10	751.23	751.36	751.48	57.10
57.20	751.48	751.61	751.73	751.86	751.99	752.11	752.24	752.37	752.49	752.62	752.75	57.20
57.30	752.75	752.87	753.00	753.13	753.25	753.38	753.50	753.63	753.76	753.88	754.01	57.30
57.40	754.01	754.14	754.26	754.39	754.52	754.64	754.77	754.90	755.02	755.15	755.27	57.40
57.50	755.27	755.40	755.53	755.65	755.78	755.91	756.03	756.16	756.29	756.41	756.54	57.50
57.60	756.54	756.67	756.79	756.92	757.05	757.17	757.30	757.43	757.55	757.68	757.81	57.60
57.70	757.81	757.93	758.06	758.18	758.31	758.44	758.56	758.69	758.82	758.94	759.07	57.70
57.80	759.07	759.20	759.32	759.45	759.58	759.70	759.83	759.96	760.08	760.21	760.34	57.80
57.90	760.34	760.46	760.59	760.72	760.84	760.97	761.10	761.22	761.35	761.48	761.60	57.90
58.00	761.60	761.73	761.86	761.98	762.11	762.24	762.36	762.49	762.62	762.74	762.87	58.00
58.10	762.87	763.00	763.12	763.25	763.38	763.50	763.63	763.76	763.88	764.01	764.14	58.10
58.20	764.14	764.26	764.39	764.52	764.64	764.77	764.90	765.02	765.15	765.28	765.40	58.20
58.30	765.40	765.53	765.66	765.78	765.91	766.04	766.16	766.29	766.42	766.54	766.67	58.30
58.40	766.67	766.80	766.92	767.05	767.18	767.30	767.43	767.56	767.68	767.81	767.94	58.40
58.50	767.94	768.06	768.19	768.32	768.44	768.57	768.70	768.82	768.95	769.08	769.20	58.50
58.60	769.20	769.33	769.46	769.58	769.71	769.84	769.97	770.09	770.22	770.35	770.47	58.60
58.70	770.47	770.60	770.73	770.85	770.98	771.11	771.23	771.36	771.49	771.61	771.74	58.70
58.80	771.74	771.87	771.99	772.12	772.25	772.37	772.50	772.63	772.76	772.88	773.01	58.80
58.90	773.01	773.14	773.26	773.39	773.52	773.64	773.77	773.90	774.02	774.15	774.28	58.90
59.00	774.28	774.40	774.53	774.66	774.79	774.91	775.04	775.17	775.29	775.42	775.55	59.00
59.10	775.55	775.67	775.80	775.93	776.05	776.18	776.31	776.44	776.56	776.69	776.82	59.10
59.20	776.82	776.94	777.07	777.20	777.32	777.45	777.58	777.71	777.83	777.96	778.09	59.20
59.30	778.09	778.21	778.34	778.47	778.59	778.72	778.85	778.98	779.10	779.23	779.36	59.30
59.40	779.36	779.48	779.61	779.74	779.86	779.99	780.12	780.25	780.37	780.50	780.63	59.40
59.50	780.63	780.75	780.88	781.01	781.13	781.26	781.39	781.52	781.64	781.77	781.90	59.50
59.60	781.90	782.02	782.15	782.28	782.41	782.53	782.66	782.79	782.91	783.04	783.17	59.60
59.70	783.17	783.29	783.42	783.55	783.68	783.80	783.93	784.06	784.18	784.31	784.44	59.70
59.80	784.44	784.57	784.69	784.82	784.95	785.07	785.20	785.33	785.46	785.58	785.71	59.80
59.90	785.71	785.84	785.96	786.09	786.22	786.35	786.47	786.60	786.73	786.85	786.98	59.90
60.00	786.98	787.11	787.24	787.36	787.49	787.62	787.75	787.87	788.00	788.13	788.25	60.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
60.00	786.98	787.11	787.24	787.36	787.49	787.62	787.75	787.87	788.00	788.13	788.25	60.00
60.10	788.25	788.38	788.51	788.64	788.76	788.89	789.02	789.14	789.27	789.40	789.53	60.10
60.20	789.53	789.65	789.78	789.91	790.04	790.16	790.29	790.42	790.54	790.67	790.80	60.20
60.30	790.80	790.93	791.05	791.18	791.31	791.44	791.56	791.69	791.82	791.94	792.07	60.30
60.40	792.07	792.20	792.33	792.45	792.58	792.71	792.84	792.96	793.09	793.22	793.35	60.40
60.50	793.35	793.47	793.60	793.73	793.85	793.98	794.11	794.24	794.36	794.49	794.62	60.50
60.60	794.62	794.75	794.87	795.00	795.13	795.26	795.38	795.51	795.64	795.77	795.89	60.60
60.70	795.89	796.02	796.15	796.27	796.40	796.53	796.66	796.78	796.91	797.04	797.17	60.70
60.80	797.17	797.29	797.42	797.55	797.68	797.80	797.93	798.06	798.19	798.31	798.44	60.80
60.90	798.44	798.57	798.70	798.82	798.95	799.08	799.21	799.33	799.46	799.59	799.72	60.90
61.00	799.72	799.84	799.97	800.10	800.23	800.35	800.48	800.61	800.74	800.86	800.99	61.00
61.10	800.99	801.12	801.25	801.37	801.50	801.63	801.76	801.88	802.01	802.14	802.27	61.10
61.20	802.27	802.39	802.52	802.65	802.78	802.90	803.03	803.16	803.29	803.41	803.54	61.20
61.30	803.54	803.67	803.80	803.92	804.05	804.18	804.31	804.44	804.56	804.69	804.82	61.30
61.40	804.82	804.95	805.07	805.20	805.33	805.46	805.58	805.71	805.84	805.97	806.09	61.40
61.50	806.09	806.22	806.35	806.48	806.61	806.73	806.86	806.99	807.12	807.24	807.37	61.50
61.60	807.37	807.50	807.63	807.75	807.88	808.01	808.14	808.26	808.39	808.52	808.65	61.60
61.70	808.65	808.78	808.90	809.03	809.16	809.29	809.41	809.54	809.67	809.80	809.93	61.70
61.80	809.93	810.05	810.18	810.31	810.44	810.56	810.69	810.82	810.95	811.08	811.20	61.80
61.90	811.20	811.33	811.46	811.59	811.71	811.84	811.97	812.10	812.23	812.35	812.48	61.90
62.00	812.48	812.61	812.74	812.86	812.99	813.12	813.25	813.38	813.50	813.63	813.76	62.00
62.10	813.76	813.89	814.01	814.14	814.27	814.40	814.53	814.65	814.78	814.91	815.04	62.10
62.20	815.04	815.17	815.29	815.42	815.55	815.68	815.80	815.93	816.06	816.19	816.32	62.20
62.30	816.32	816.44	816.57	816.70	816.83	816.96	817.08	817.21	817.34	817.47	817.60	62.30
62.40	817.60	817.72	817.85	817.98	818.11	818.24	818.36	818.49	818.62	818.75	818.88	62.40
62.50	818.88	819.00	819.13	819.26	819.39	819.52	819.64	819.77	819.90	820.03	820.16	62.50
62.60	820.16	820.28	820.41	820.54	820.67	820.80	820.92	821.05	821.18	821.31	821.44	62.60
62.70	821.44	821.56	821.69	821.82	821.95	822.08	822.20	822.33	822.46	822.59	822.72	62.70
62.80	822.72	822.84	822.97	823.10	823.23	823.36	823.48	823.61	823.74	823.87	824.00	62.80
62.90	824.00	824.12	824.25	824.38	824.51	824.64	824.77	824.89	825.02	825.15	825.28	62.90
63.00	825.28	825.41	825.53	825.66	825.79	825.92	826.05	826.18	826.30	826.43	826.56	63.00
63.10	826.56	826.69	826.82	826.94	827.07	827.20	827.33	827.46	827.59	827.71	827.84	63.10
63.20	827.84	827.97	828.10	828.23	828.35	828.48	828.61	828.74	828.87	829.00	829.12	63.20
63.30	829.12	829.25	829.38	829.51	829.64	829.76	829.89	830.02	830.15	830.28	830.41	63.30
63.40	830.41	830.53	830.66	830.79	830.92	831.05	831.18	831.30	831.43	831.56	831.69	63.40
63.50	831.69	831.82	831.95	832.07	832.20	832.33	832.46	832.59	832.72	832.84	832.97	63.50
63.60	832.97	833.10	833.23	833.36	833.49	833.61	833.74	833.87	834.00	834.13	834.26	63.60
63.70	834.26	834.38	834.51	834.64	834.77	834.90	835.03	835.15	835.28	835.41	835.54	63.70
63.80	835.54	835.67	835.80	835.93	836.05	836.18	836.31	836.44	836.57	836.70	836.82	63.80
63.90	836.82	836.95	837.08	837.21	837.34	837.47	837.60	837.72	837.85	837.98	838.11	63.90
64.00	838.11	838.24	838.37	838.49	838.62	838.75	838.88	839.01	839.14	839.27	839.39	64.00
64.10	839.39	839.52	839.65	839.78	839.91	840.04	840.17	840.29	840.42	840.55	840.68	64.10
64.20	840.68	840.81	840.94	841.07	841.19	841.32	841.45	841.58	841.71	841.84	841.97	64.20
64.30	841.97	842.09	842.22	842.35	842.48	842.61	842.74	842.87	842.99	843.12	843.25	64.30
64.40	843.25	843.38	843.51	843.64	843.77	843.89	844.02	844.15	844.28	844.41	844.54	64.40
64.50	844.54	844.67	844.80	844.92	845.05	845.18	845.31	845.44	845.57	845.70	845.82	64.50
64.60	845.82	845.95	846.08	846.21	846.34	846.47	846.60	846.73	846.85	846.98	847.11	64.60
64.70	847.11	847.24	847.37	847.50	847.63	847.76	847.88	848.01	848.14	848.27	848.40	64.70
64.80	848.40	848.53	848.66	848.79	848.91	849.04	849.17	849.30	849.43	849.56	849.69	64.80
64.90	849.69	849.82	849.94	850.07	850.20	850.33	850.46	850.59	850.72	850.85	850.98	64.90
65.00	850.98	851.10	851.23	851.36	851.49	851.62	851.75	851.88	852.01	852.14	852.26	65.00
65.10	852.26	852.39	852.52	852.65	852.78	852.91	853.04	853.17	853.30	853.42	853.55	65.10
65.20	853.55	853.68	853.81	853.94	854.07	854.20	854.33	854.46	854.58	854.71	854.84	65.20
65.30	854.84	854.97	855.10	855.23	855.36	855.49	855.62	855.75	855.87	856.00	856.13	65.30
65.40	856.13	856.26	856.39	856.52	856.65	856.78	856.91	857.04	857.16	857.29	857.42	65.40
65.50	857.42	857.55	857.68	857.81	857.94	858.07	858.20	858.33	858.45	858.58	858.71	65.50
65.60	858.71	858.84	858.97	859.10	859.23	859.36	859.49	859.62	859.75	859.87	860.00	65.60
65.70	860.00	860.13	860.26	860.39	860.52	860.65	860.78	860.91	861.04	861.17	861.30	65.70
65.80	861.30	861.42	861.55	861.68	861.81	861.94	862.07	862.20	862.33	862.46	862.59	65.80
65.90	862.59	862.72	862.85	862.97	863.10	863.23	863.36	863.49	863.62	863.75	863.88	65.90
66.00	863.88	864.01	864.14	864.27	864.40	864.52	864.65	864.78	864.91	865.04	865.17	66.00

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
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TABLE A5.2.1. *Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (1PTS 1968)												
66.00	863.88	864.01	864.14	864.27	864.40	864.52	864.65	864.78	864.91	865.04	865.17	66.00
66.10	865.17	865.30	865.43	865.56	865.69	865.82	865.95	866.08	866.21	866.33	866.46	66.10
66.20	866.46	866.59	866.72	866.85	866.98	867.11	867.24	867.37	867.50	867.63	867.76	66.20
66.30	867.76	867.89	868.02	868.15	868.27	868.40	868.53	868.66	868.79	868.92	869.05	66.30
66.40	869.05	869.18	869.31	869.44	869.57	869.70	869.83	869.96	870.09	870.22	870.34	66.40
66.50	870.34	870.47	870.60	870.73	870.86	870.99	871.12	871.25	871.38	871.51	871.64	66.50
66.60	871.64	871.77	871.90	872.03	872.16	872.29	872.42	872.55	872.68	872.80	872.93	66.60
66.70	872.93	873.06	873.19	873.32	873.45	873.58	873.71	873.84	873.97	874.10	874.23	66.70
66.80	874.23	874.36	874.49	874.62	874.75	874.88	875.01	875.14	875.27	875.40	875.53	66.80
66.90	875.53	875.65	875.78	875.91	876.04	876.17	876.30	876.43	876.56	876.69	876.82	66.90
67.00	876.82	876.95	877.08	877.21	877.34	877.47	877.60	877.73	877.86	877.99	878.12	67.00
67.10	878.12	878.25	878.38	878.51	878.64	878.77	878.90	879.03	879.15	879.28	879.41	67.10
67.20	879.41	879.54	879.67	879.80	879.93	880.06	880.19	880.32	880.45	880.58	880.71	67.20
67.30	880.71	880.84	880.97	881.10	881.23	881.36	881.49	881.62	881.75	881.88	882.01	67.30
67.40	882.01	882.14	882.27	882.40	882.53	882.66	882.79	882.92	883.05	883.18	883.31	67.40
67.50	883.31	883.44	883.57	883.70	883.83	883.96	884.09	884.22	884.35	884.48	884.61	67.50
67.60	884.61	884.74	884.87	885.00	885.13	885.26	885.39	885.51	885.64	885.77	885.90	67.60
67.70	885.90	886.03	886.16	886.29	886.42	886.55	886.68	886.81	886.94	887.07	887.20	67.70
67.80	887.20	887.33	887.46	887.59	887.72	887.85	887.98	888.11	888.24	888.37	888.50	67.80
67.90	888.50	888.63	888.76	888.89	889.02	889.15	889.28	889.41	889.54	889.67	889.80	67.90
68.00	889.80	889.93	890.06	890.19	890.32	890.45	890.58	890.71	890.84	890.97	891.10	68.00
68.10	891.10	891.23	891.36	891.49	891.62	891.75	891.88	892.02	892.15	892.28	892.41	68.10
68.20	892.41	892.54	892.67	892.80	892.93	893.06	893.19	893.32	893.45	893.58	893.71	68.20
68.30	893.71	893.84	893.97	894.10	894.23	894.36	894.49	894.62	894.75	894.88	895.01	68.30
68.40	895.01	895.14	895.27	895.40	895.53	895.66	895.79	895.92	896.05	896.18	896.31	68.40
68.50	896.31	896.44	896.57	896.70	896.83	896.96	897.09	897.22	897.35	897.48	897.61	68.50
68.60	897.61	897.74	897.87	898.00	898.13	898.26	898.40	898.53	898.66	898.79	898.92	68.60
68.70	898.92	899.05	899.18	899.31	899.44	899.57	899.70	899.83	899.96	900.09	900.22	68.70
68.80	900.22	900.35	900.48	900.61	900.74	900.87	901.00	901.13	901.26	901.39	901.52	68.80
68.90	901.52	901.65	901.79	901.92	902.05	902.18	902.31	902.44	902.57	902.70	902.83	68.90
69.00	902.83	902.96	903.09	903.22	903.35	903.48	903.61	903.74	903.87	904.00	904.13	69.00
69.10	904.13	904.26	904.39	904.53	904.66	904.79	904.92	905.05	905.18	905.31	905.44	69.10
69.20	905.44	905.57	905.70	905.83	905.96	906.09	906.22	906.35	906.48	906.61	906.74	69.20
69.30	906.74	906.88	907.01	907.14	907.27	907.40	907.53	907.66	907.79	907.92	908.05	69.30
69.40	908.05	908.18	908.31	908.44	908.57	908.70	908.83	908.97	909.10	909.23	909.36	69.40
69.50	909.36	909.49	909.62	909.75	909.88	910.01	910.14	910.27	910.40	910.53	910.66	69.50
69.60	910.66	910.80	910.93	911.06	911.19	911.32	911.45	911.58	911.71	911.84	911.97	69.60
69.70	911.97	912.10	912.23	912.36	912.50	912.63	912.76	912.89	913.02	913.15	913.28	69.70
69.80	913.28	913.41	913.54	913.67	913.80	913.93	914.07	914.20	914.33	914.46	914.59	69.80
69.90	914.59	914.72	914.85	914.98	915.11	915.24	915.37	915.50	915.64	915.77	915.90	69.90
70.00	915.90	916.03	916.16	916.29	916.42	916.55	916.68	916.81	916.95	917.08	917.21	70.00
70.10	917.21	917.34	917.47	917.60	917.73	917.86	917.99	918.12	918.25	918.39	918.52	70.10
70.20	918.52	918.65	918.78	918.91	919.04	919.17	919.30	919.43	919.56	919.70	919.83	70.20
70.30	919.83	919.96	920.09	920.22	920.35	920.48	920.61	920.74	920.88	921.01	921.14	70.30
70.40	921.14	921.27	921.40	921.53	921.66	921.79	921.92	922.06	922.19	922.32	922.45	70.40
70.50	922.45	922.58	922.71	922.84	922.97	923.10	923.24	923.37	923.50	923.63	923.76	70.50
70.60	923.76	923.89	924.02	924.15	924.29	924.42	924.55	924.68	924.81	924.94	925.07	70.60
70.70	925.07	925.20	925.33	925.47	925.60	925.73	925.86	925.99	926.12	926.25	926.38	70.70
70.80	926.38	926.52	926.65	926.78	926.91	927.04	927.17	927.30	927.44	927.57	927.70	70.80
70.90	927.70	927.83	927.96	928.09	928.22	928.35	928.49	928.62	928.75	928.88	929.01	70.90
71.00	929.01	929.14	929.27	929.41	929.54	929.67	929.80	929.93	930.06	930.19	930.32	71.00
71.10	930.32	930.46	930.59	930.72	930.85	930.98	931.11	931.24	931.38	931.51	931.64	71.10
71.20	931.64	931.77	931.90	932.03	932.17	932.30	932.43	932.56	932.69	932.82	932.95	71.20
71.30	932.95	933.09	933.22	933.35	933.48	933.61	933.74	933.87	934.01	934.14	934.27	71.30
71.40	934.27	934.40	934.53	934.66	934.80	934.93	935.06	935.19	935.32	935.45	935.58	71.40
71.50	935.58	935.72	935.85	935.98	936.11	936.24	936.37	936.51	936.64	936.77	936.90	71.50
71.60	936.90	937.03	937.16	937.30	937.43	937.56	937.69	937.82	937.95	938.09	938.22	71.60
71.70	938.22	938.35	938.48	938.61	938.74	938.88	939.01	939.14	939.27	939.40	939.53	71.70
71.80	939.53	939.67	939.80	939.93	940.06	940.19	940.32	940.46	940.59	940.72	940.85	71.80
71.90	940.85	940.98	941.12	941.25	941.38	941.51	941.64	941.77	941.91	942.04	942.17	71.90
72.00	942.17	942.30	942.43	942.57	942.70	942.83	942.96	943.09	943.22	943.36	943.49	72.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.1. *Type E thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
72.00	942.17	942.30	942.43	942.57	942.70	942.83	942.96	943.09	943.22	943.36	943.49	72.00
72.10	943.49	943.62	943.75	943.88	944.02	944.15	944.28	944.41	944.54	944.68	944.81	72.10
72.20	944.81	944.94	945.07	945.20	945.33	945.47	945.60	945.73	945.86	945.99	946.13	72.20
72.30	946.13	946.26	946.39	946.52	946.65	946.79	946.92	947.05	947.18	947.31	947.45	72.30
72.40	947.45	947.58	947.71	947.84	947.97	948.11	948.24	948.37	948.50	948.63	948.77	72.40
72.50	948.77	948.90	949.03	949.16	949.29	949.43	949.56	949.69	949.82	949.95	950.09	72.50
72.60	950.09	950.22	950.35	950.48	950.62	950.75	950.88	951.01	951.14	951.28	951.41	72.60
72.70	951.41	951.54	951.67	951.80	951.94	952.07	952.20	952.33	952.47	952.60	952.73	72.70
72.80	952.73	952.86	952.99	953.13	953.26	953.39	953.52	953.65	953.79	953.92	954.05	72.80
72.90	954.05	954.18	954.32	954.45	954.58	954.71	954.84	954.98	955.11	955.24	955.37	72.90
73.00	955.37	955.51	955.64	955.77	955.90	956.03	956.17	956.30	956.43	956.56	956.70	73.00
73.10	956.70	956.83	956.96	957.09	957.23	957.36	957.49	957.62	957.75	957.89	958.02	73.10
73.20	958.02	958.15	958.28	958.42	958.55	958.68	958.81	958.95	959.08	959.21	959.34	73.20
73.30	959.34	959.48	959.61	959.74	959.87	960.01	960.14	960.27	960.40	960.53	960.67	73.30
73.40	960.67	960.80	960.93	961.06	961.20	961.33	961.46	961.59	961.73	961.86	961.99	73.40
73.50	961.99	962.12	962.26	962.39	962.52	962.65	962.79	962.92	963.05	963.18	963.32	73.50
73.60	963.32	963.45	963.58	963.71	963.85	963.98	964.11	964.24	964.38	964.51	964.64	73.60
73.70	964.64	964.77	964.91	965.04	965.17	965.31	965.44	965.57	965.70	965.84	965.97	73.70
73.80	965.97	966.10	966.23	966.37	966.50	966.63	966.76	966.90	967.03	967.16	967.29	73.80
73.90	967.29	967.43	967.56	967.69	967.82	967.96	968.09	968.22	968.36	968.49	968.62	73.90
74.00	968.62	968.75	968.89	969.02	969.15	969.28	969.42	969.55	969.68	969.82	969.95	74.00
74.10	969.95	970.08	970.21	970.35	970.48	970.61	970.74	970.88	971.01	971.14	971.28	74.10
74.20	971.28	971.41	971.54	971.67	971.81	971.94	972.07	972.20	972.34	972.47	972.60	74.20
74.30	972.60	972.74	972.87	973.00	973.13	973.27	973.40	973.53	973.67	973.80	973.93	74.30
74.40	973.93	974.06	974.20	974.33	974.46	974.60	974.73	974.86	974.99	975.13	975.26	74.40
74.50	975.26	975.39	975.53	975.66	975.79	975.92	976.06	976.19	976.32	976.46	976.59	74.50
74.60	976.59	976.72	976.85	976.99	977.12	977.25	977.39	977.52	977.65	977.78	977.92	74.60
74.70	977.92	978.05	978.18	978.32	978.45	978.58	978.72	978.85	978.98	979.11	979.25	74.70
74.80	979.25	979.38	979.51	979.65	979.78	979.91	980.05	980.18	980.31	980.44	980.58	74.80
74.90	980.58	980.71	980.84	980.98	981.11	981.24	981.38	981.51	981.64	981.77	981.91	74.90
75.00	981.91	982.04	982.17	982.31	982.44	982.57	982.71	982.84	982.97	983.11	983.24	75.00
75.10	983.24	983.37	983.50	983.64	983.77	983.90	984.04	984.17	984.30	984.44	984.57	75.10
75.20	984.57	984.70	984.84	984.97	985.10	985.24	985.37	985.50	985.64	985.77	985.90	75.20
75.30	985.90	986.03	986.17	986.30	986.43	986.57	986.70	986.83	986.97	987.10	987.23	75.30
75.40	987.23	987.37	987.50	987.63	987.77	987.90	988.03	988.17	988.30	988.43	988.57	75.40
75.50	988.57	988.70	988.83	988.96	989.10	989.23	989.36	989.50	989.63	989.76	989.90	75.50
75.60	989.90	990.03	990.16	990.30	990.43	990.56	990.70	990.83	990.96	991.10	991.23	75.60
75.70	991.23	991.36	991.50	991.63	991.76	991.90	992.03	992.16	992.30	992.43	992.56	75.70
75.80	992.56	992.70	992.83	992.96	993.10	993.23	993.36	993.50	993.63	993.76	993.90	75.80
75.90	993.90	994.03	994.16	994.30	994.43	994.56	994.70	994.83	994.96	995.10	995.23	75.90
76.00	995.23	995.36	995.50	995.63	995.76	995.90	996.03	996.16	996.30	996.43	996.56	76.00
76.10	996.56	996.70	996.83	996.96	997.10	997.23	997.36	997.50	997.63	997.76	997.90	76.10
76.20	997.90	998.03	998.16	998.30	998.43	998.57	998.70	998.83	998.97	999.10	999.23	76.20
76.30	999.23	999.37	999.50	999.63	999.77	999.90						76.30
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. *Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
-9.80	-437.03	-440.41	-444.42	-449.76								-9.80
-9.70	-414.66	-416.43	-418.27	-420.19	-422.18	-424.28	-426.48	-428.83	-431.33	-434.05	-437.03	-9.70
-9.60	-399.44	-400.80	-402.20	-403.62	-405.08	-406.57	-408.10	-409.67	-411.28	-412.94	-414.66	-9.60
-9.50	-387.01	-388.17	-389.34	-390.53	-391.74	-392.97	-394.22	-395.49	-396.78	-398.10	-399.44	-9.50
-9.40	-376.18	-377.21	-378.25	-379.30	-380.36	-381.44	-382.52	-383.62	-384.74	-385.87	-387.01	-9.40
-9.30	-366.41	-367.35	-368.30	-369.25	-370.22	-371.19	-372.17	-373.16	-374.15	-375.16	-376.18	-9.30
-9.20	-357.41	-358.29	-359.16	-360.05	-360.94	-361.83	-362.73	-363.64	-364.56	-365.48	-366.41	-9.20
-9.10	-349.00	-349.82	-350.64	-351.47	-352.30	-353.14	-353.99	-354.84	-355.69	-356.55	-357.41	-9.10
-9.00	-341.05	-341.83	-342.61	-343.39	-344.18	-344.98	-345.77	-346.57	-347.38	-348.19	-349.00	-9.00
-8.90	-333.49	-334.23	-334.98	-335.72	-336.48	-337.23	-337.99	-338.75	-339.51	-340.28	-341.05	-8.90
-8.80	-326.25	-326.96	-327.68	-328.39	-329.11	-329.84	-330.56	-331.29	-332.02	-332.76	-333.49	-8.80
-8.70	-319.29	-319.98	-320.67	-321.35	-322.05	-322.74	-323.44	-324.14	-324.84	-325.55	-326.25	-8.70
-8.60	-312.58	-313.24	-313.90	-314.57	-315.24	-315.91	-316.58	-317.25	-317.93	-318.61	-319.29	-8.60
-8.50	-306.07	-306.71	-307.36	-308.00	-308.65	-309.30	-309.95	-310.60	-311.26	-311.92	-312.58	-8.50
-8.40	-299.76	-300.38	-301.01	-301.63	-302.26	-302.89	-303.52	-304.16	-304.79	-305.43	-306.07	-8.40
-8.30	-293.62	-294.22	-294.83	-295.44	-296.05	-296.67	-297.28	-297.90	-298.52	-299.14	-299.76	-8.30
-8.20	-287.63	-288.22	-288.82	-289.41	-290.01	-290.61	-291.20	-291.81	-292.41	-293.01	-293.62	-8.20
-8.10	-281.79	-282.37	-282.95	-283.53	-284.11	-284.69	-285.28	-285.87	-286.45	-287.04	-287.63	-8.10
-8.00	-276.08	-276.64	-277.21	-277.78	-278.35	-278.92	-279.49	-280.06	-280.64	-281.21	-281.79	-8.00
-7.90	-270.49	-271.04	-271.60	-272.15	-272.71	-273.27	-273.83	-274.39	-274.95	-275.51	-276.08	-7.90
-7.80	-265.01	-265.55	-266.10	-266.64	-267.19	-267.74	-268.28	-268.83	-269.38	-269.94	-270.49	-7.80
-7.70	-259.64	-260.17	-260.70	-261.24	-261.77	-262.31	-262.85	-263.39	-263.93	-264.47	-265.01	-7.70
-7.60	-254.36	-254.88	-255.41	-255.93	-256.46	-256.99	-257.51	-258.04	-258.57	-259.10	-259.64	-7.60
-7.50	-249.17	-249.69	-250.20	-250.72	-251.24	-251.75	-252.27	-252.79	-253.31	-253.84	-254.36	-7.50
-7.40	-244.07	-244.58	-245.08	-245.59	-246.10	-246.61	-247.12	-247.63	-248.14	-248.66	-249.17	-7.40
-7.30	-239.05	-239.55	-240.05	-240.55	-241.05	-241.55	-242.05	-242.56	-243.06	-243.56	-244.07	-7.30
-7.20	-234.10	-234.59	-235.09	-235.58	-236.07	-236.57	-237.06	-237.56	-238.05	-238.55	-239.05	-7.20
-7.10	-229.23	-229.71	-230.20	-230.68	-231.17	-231.66	-232.14	-232.63	-233.12	-233.61	-234.10	-7.10
-7.00	-224.42	-224.90	-225.38	-225.86	-226.34	-226.82	-227.30	-227.78	-228.26	-228.74	-229.23	-7.00
-6.90	-219.68	-220.15	-220.62	-221.09	-221.57	-222.04	-222.52	-222.99	-223.47	-223.94	-224.42	-6.90
-6.80	-214.99	-215.46	-215.93	-216.39	-216.86	-217.33	-217.80	-218.27	-218.74	-219.21	-219.68	-6.80
-6.70	-210.37	-210.83	-211.29	-211.75	-212.21	-212.68	-213.14	-213.60	-214.06	-214.53	-214.99	-6.70
-6.60	-205.80	-206.26	-206.71	-207.17	-207.62	-208.08	-208.54	-208.99	-209.45	-209.91	-210.37	-6.60
-6.50	-201.29	-201.73	-202.18	-202.63	-203.09	-203.54	-203.99	-204.44	-204.89	-205.35	-205.80	-6.50
-6.40	-196.82	-197.26	-197.71	-198.15	-198.60	-199.05	-199.49	-199.94	-200.39	-200.84	-201.29	-6.40
-6.30	-192.40	-192.84	-193.28	-193.72	-194.16	-194.61	-195.05	-195.49	-195.93	-196.38	-196.82	-6.30
-6.20	-188.03	-188.47	-188.90	-189.34	-189.78	-190.21	-190.65	-191.09	-191.53	-191.96	-192.40	-6.20
-6.10	-183.71	-184.14	-184.57	-185.00	-185.43	-185.86	-186.30	-186.73	-187.16	-187.60	-188.03	-6.10
-6.00	-179.43	-179.85	-180.28	-180.71	-181.13	-181.56	-181.99	-182.42	-182.85	-183.28	-183.71	-6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. Type E thermocouples—temperature ($^{\circ}\text{F}$) as a function of thermoelectric voltage, reference junctions at 32°F —Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
-6.00	-179.43	-179.85	-180.28	-180.71	-181.13	-181.56	-181.99	-182.42	-182.85	-183.28	-183.71	-6.00
-5.90	-175.18	-175.61	-176.03	-176.45	-176.88	-177.30	-177.72	-178.15	-178.57	-179.00	-179.43	-5.90
-5.80	-170.98	-171.40	-171.82	-172.24	-172.66	-173.08	-173.50	-173.92	-174.34	-174.76	-175.18	-5.80
-5.70	-166.82	-167.24	-167.65	-168.07	-168.48	-168.90	-169.31	-169.73	-170.15	-170.57	-170.98	-5.70
-5.60	-162.70	-163.11	-163.52	-163.93	-164.34	-164.75	-165.17	-165.58	-165.99	-166.41	-166.82	-5.60
-5.50	-158.61	-159.01	-159.42	-159.83	-160.24	-160.65	-161.06	-161.47	-161.87	-162.29	-162.70	-5.50
-5.40	-154.55	-154.96	-155.36	-155.76	-156.17	-156.57	-156.98	-157.39	-157.79	-158.20	-158.61	-5.40
-5.30	-150.53	-150.93	-151.33	-151.73	-152.13	-152.54	-152.94	-153.34	-153.74	-154.15	-154.55	-5.30
-5.20	-146.54	-146.94	-147.34	-147.74	-148.13	-148.53	-148.93	-149.33	-149.73	-150.13	-150.53	-5.20
-5.10	-142.58	-142.98	-143.37	-143.77	-144.16	-144.56	-144.96	-145.35	-145.75	-146.14	-146.54	-5.10
-5.00	-138.66	-139.05	-139.44	-139.83	-140.23	-140.62	-141.01	-141.40	-141.80	-142.19	-142.58	-5.00
-4.90	-134.76	-135.15	-135.54	-135.93	-136.32	-136.71	-137.10	-137.49	-137.88	-138.27	-138.66	-4.90
-4.80	-130.89	-131.28	-131.66	-132.05	-132.44	-132.82	-133.21	-133.60	-133.98	-134.37	-134.76	-4.80
-4.70	-127.05	-127.43	-127.82	-128.20	-128.58	-128.97	-129.35	-129.74	-130.12	-130.51	-130.89	-4.70
-4.60	-123.24	-123.62	-124.00	-124.38	-124.76	-125.14	-125.52	-125.90	-126.29	-126.67	-127.05	-4.60
-4.50	-119.45	-119.83	-120.21	-120.58	-120.96	-121.34	-121.72	-122.10	-122.48	-122.86	-123.24	-4.50
-4.40	-115.69	-116.06	-116.44	-116.81	-117.19	-117.57	-117.94	-118.32	-118.70	-119.07	-119.45	-4.40
-4.30	-111.95	-112.32	-112.70	-113.07	-113.44	-113.82	-114.19	-114.56	-114.94	-115.31	-115.69	-4.30
-4.20	-108.24	-108.61	-108.98	-109.35	-109.72	-110.09	-110.46	-110.83	-111.21	-111.58	-111.95	-4.20
-4.10	-104.55	-104.91	-105.28	-105.65	-106.02	-106.39	-106.76	-107.13	-107.50	-107.87	-108.24	-4.10
-4.00	-100.88	-101.25	-101.61	-101.98	-102.34	-102.71	-103.08	-103.44	-103.81	-104.18	-104.55	-4.00
-3.90	-97.23	-97.60	-97.96	-98.33	-98.69	-99.05	-99.42	-99.78	-100.15	-100.51	-100.88	-3.90
-3.80	-93.61	-93.97	-94.33	-94.70	-95.06	-95.42	-95.78	-96.14	-96.51	-96.87	-97.23	-3.80
-3.70	-90.01	-90.37	-90.73	-91.09	-91.45	-91.81	-92.17	-92.53	-92.89	-93.25	-93.61	-3.70
-3.60	-86.43	-86.78	-87.14	-87.50	-87.86	-88.21	-88.57	-88.93	-89.29	-89.65	-90.01	-3.60
-3.50	-82.86	-83.22	-83.57	-83.93	-84.29	-84.64	-85.00	-85.36	-85.71	-86.07	-86.43	-3.50
-3.40	-79.32	-79.67	-80.03	-80.38	-80.74	-81.09	-81.44	-81.80	-82.15	-82.51	-82.86	-3.40
-3.30	-75.80	-76.15	-76.50	-76.85	-77.20	-77.56	-77.91	-78.26	-78.61	-78.97	-79.32	-3.30
-3.20	-72.29	-72.64	-72.99	-73.34	-73.69	-74.04	-74.39	-74.74	-75.10	-75.45	-75.80	-3.20
-3.10	-68.81	-69.15	-69.50	-69.85	-70.20	-70.55	-70.90	-71.25	-71.59	-71.94	-72.29	-3.10
-3.00	-65.34	-65.68	-66.03	-66.38	-66.72	-67.07	-67.42	-67.76	-68.11	-68.46	-68.81	-3.00
-2.90	-61.89	-62.23	-62.58	-62.92	-63.26	-63.61	-63.95	-64.30	-64.65	-64.99	-65.34	-2.90
-2.80	-58.45	-58.79	-59.14	-59.48	-59.82	-60.17	-60.51	-60.85	-61.20	-61.54	-61.89	-2.80
-2.70	-55.03	-55.38	-55.72	-56.06	-56.40	-56.74	-57.08	-57.42	-57.77	-58.11	-58.45	-2.70
-2.60	-51.63	-51.97	-52.31	-52.65	-52.99	-53.33	-53.67	-54.01	-54.35	-54.69	-55.03	-2.60
-2.50	-48.25	-48.59	-48.92	-49.26	-49.60	-49.94	-50.28	-50.62	-50.95	-51.29	-51.63	-2.50
-2.40	-44.88	-45.21	-45.55	-45.89	-46.22	-46.56	-46.90	-47.23	-47.57	-47.91	-48.25	-2.40
-2.30	-41.52	-41.86	-42.19	-42.53	-42.86	-43.20	-43.53	-43.87	-44.21	-44.54	-44.88	-2.30
-2.20	-38.18	-38.52	-38.85	-39.18	-39.52	-39.85	-40.19	-40.52	-40.85	-41.19	-41.52	-2.20
-2.10	-34.86	-35.19	-35.52	-35.86	-36.19	-36.52	-36.85	-37.19	-37.52	-37.85	-38.18	-2.10
-2.00	-31.55	-31.88	-32.21	-32.54	-32.87	-33.20	-33.53	-33.86	-34.20	-34.53	-34.86	-2.00
-1.90	-28.25	-28.58	-28.91	-29.24	-29.57	-29.90	-30.23	-30.56	-30.89	-31.22	-31.55	-1.90
-1.80	-24.97	-25.30	-25.63	-25.95	-26.28	-26.61	-26.94	-27.27	-27.60	-27.92	-28.25	-1.80
-1.70	-21.70	-22.03	-22.35	-22.68	-23.01	-23.33	-23.66	-23.99	-24.32	-24.64	-24.97	-1.70
-1.60	-18.45	-18.77	-19.10	-19.42	-19.75	-20.07	-20.40	-20.72	-21.05	-21.38	-21.70	-1.60
-1.50	-15.20	-15.53	-15.85	-16.18	-16.50	-16.82	-17.15	-17.47	-17.80	-18.12	-18.45	-1.50
-1.40	-11.98	-12.30	-12.62	-12.94	-13.27	-13.59	-13.91	-14.23	-14.56	-14.88	-15.20	-1.40
-1.30	-8.76	-9.08	-9.40	-9.72	-10.04	-10.37	-10.69	-11.01	-11.33	-11.65	-11.98	-1.30
-1.20	-5.55	-5.87	-6.19	-6.51	-6.83	-7.16	-7.48	-7.80	-8.12	-8.44	-8.76	-1.20
-1.10	-2.36	-2.68	-3.00	-3.32	-3.64	-3.96	-4.28	-4.60	-4.92	-5.23	-5.55	-1.10
-1.00	0.82	0.50	0.18	-0.14	-0.45	-0.77	-1.09	-1.41	-1.73	-2.04	-2.36	-1.00
-0.90	3.99	3.67	3.35	3.04	2.72	2.40	2.09	1.77	1.45	1.13	0.82	-0.90
-0.80	7.14	6.83	6.51	6.20	5.88	5.57	5.25	4.93	4.62	4.30	3.99	-0.80
-0.70	10.29	9.97	9.66	9.34	9.03	8.72	8.40	8.09	7.77	7.46	7.14	-0.70
-0.60	13.42	13.11	12.79	12.48	12.17	11.86	11.54	11.23	10.91	10.60	10.29	-0.60
-0.50	16.54	16.23	15.92	15.61	15.30	14.98	14.67	14.36	14.05	13.73	13.42	-0.50
-0.40	19.66	19.34	19.03	18.72	18.41	18.10	17.79	17.48	17.17	16.86	16.54	-0.40
-0.30	22.76	22.45	22.14	21.83	21.52	21.21	20.90	20.59	20.28	19.97	19.66	-0.30
-0.20	25.85	25.54	25.23	24.92	24.61	24.30	23.99	23.69	23.38	23.07	22.76	-0.20
-0.10	28.93	28.62	28.31	28.01	27.70	27.39	27.08	26.77	26.46	26.16	25.85	-0.10
-0.00	32.00	31.69	31.39	31.08	30.77	30.47	30.16	29.85	29.54	29.24	28.93	-0.00

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
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TABLE A5.2.2. Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
0.00	32.00	32.31	32.61	32.92	33.23	33.53	33.84	34.14	34.45	34.76	35.06	0.00
0.10	35.06	35.37	35.67	35.98	36.29	36.59	36.90	37.20	37.51	37.81	38.12	0.10
0.20	38.12	38.42	38.73	39.03	39.34	39.64	39.95	40.25	40.56	40.86	41.17	0.20
0.30	41.17	41.47	41.77	42.08	42.38	42.69	42.99	43.29	43.60	43.90	44.21	0.30
0.40	44.21	44.51	44.81	45.12	45.42	45.72	46.03	46.33	46.63	46.93	47.24	0.40
0.50	47.24	47.54	47.84	48.15	48.45	48.75	49.05	49.36	49.66	49.96	50.26	0.50
0.60	50.26	50.56	50.87	51.17	51.47	51.77	52.07	52.37	52.68	52.98	53.28	0.60
0.70	53.28	53.58	53.88	54.18	54.48	54.78	55.09	55.39	55.69	55.99	56.29	0.70
0.80	56.29	56.59	56.89	57.19	57.49	57.79	58.09	58.39	58.69	58.99	59.29	0.80
0.90	59.29	59.59	59.89	60.19	60.49	60.79	61.09	61.39	61.69	61.99	62.29	0.90
1.00	62.29	62.58	62.88	63.18	63.48	63.78	64.08	64.38	64.68	64.97	65.27	1.00
1.10	65.27	65.57	65.87	66.17	66.46	66.76	67.06	67.36	67.66	67.95	68.25	1.10
1.20	68.25	68.55	68.85	69.14	69.44	69.74	70.04	70.33	70.63	70.93	71.22	1.20
1.30	71.22	71.52	71.82	72.11	72.41	72.71	73.00	73.30	73.60	73.89	74.19	1.30
1.40	74.19	74.49	74.78	75.08	75.37	75.67	75.96	76.26	76.56	76.85	77.15	1.40
1.50	77.15	77.44	77.74	78.03	78.33	78.62	78.92	79.21	79.51	79.80	80.10	1.50
1.60	80.10	80.39	80.69	80.98	81.28	81.57	81.86	82.16	82.45	82.75	83.04	1.60
1.70	83.04	83.33	83.63	83.92	84.22	84.51	84.80	85.10	85.39	85.68	85.98	1.70
1.80	85.98	86.27	86.56	86.86	87.15	87.44	87.73	88.03	88.32	88.61	88.90	1.80
1.90	88.90	89.20	89.49	89.78	90.07	90.37	90.66	90.95	91.24	91.53	91.83	1.90
2.00	91.83	92.12	92.41	92.70	92.99	93.28	93.58	93.87	94.16	94.45	94.74	2.00
2.10	94.74	95.03	95.32	95.61	95.91	96.20	96.49	96.78	97.07	97.36	97.65	2.10
2.20	97.65	97.94	98.23	98.52	98.81	99.10	99.39	99.68	99.97	100.26	100.55	2.20
2.30	100.55	100.84	101.13	101.42	101.71	102.00	102.29	102.58	102.87	103.15	103.44	2.30
2.40	103.44	103.73	104.02	104.31	104.60	104.89	105.18	105.47	105.75	106.04	106.33	2.40
2.50	106.33	106.62	106.91	107.20	107.48	107.77	108.06	108.35	108.64	108.92	109.21	2.50
2.60	109.21	109.50	109.79	110.07	110.36	110.65	110.94	111.22	111.51	111.80	112.09	2.60
2.70	112.09	112.37	112.66	112.95	113.23	113.52	113.81	114.09	114.38	114.67	114.95	2.70
2.80	114.95	115.24	115.53	115.81	116.10	116.38	116.67	116.96	117.24	117.53	117.81	2.80
2.90	117.81	118.10	118.38	118.67	118.96	119.24	119.53	119.81	120.10	120.38	120.67	2.90
3.00	120.67	120.95	121.24	121.52	121.81	122.09	122.38	122.66	122.95	123.23	123.51	3.00
3.10	123.51	123.80	124.08	124.37	124.65	124.94	125.22	125.50	125.79	126.07	126.36	3.10
3.20	126.36	126.64	126.92	127.21	127.49	127.77	128.06	128.34	128.62	128.91	129.19	3.20
3.30	129.19	129.47	129.76	130.04	130.32	130.60	130.89	131.17	131.45	131.74	132.02	3.30
3.40	132.02	132.30	132.58	132.87	133.15	133.43	133.71	133.99	134.28	134.56	134.84	3.40
3.50	134.84	135.12	135.40	135.69	135.97	136.25	136.53	136.81	137.09	137.37	137.66	3.50
3.60	137.66	137.94	138.22	138.50	138.78	139.06	139.34	139.62	139.90	140.19	140.47	3.60
3.70	140.47	140.75	141.03	141.31	141.59	141.87	142.15	142.43	142.71	142.99	143.27	3.70
3.80	143.27	143.55	143.83	144.11	144.39	144.67	144.95	145.23	145.51	145.79	146.07	3.80
3.90	146.07	146.35	146.63	146.91	147.18	147.46	147.74	148.02	148.30	148.58	148.86	3.90
4.00	148.86	149.14	149.42	149.70	149.97	150.25	150.53	150.81	151.09	151.37	151.64	4.00
4.10	151.64	151.92	152.20	152.48	152.76	153.04	153.31	153.59	153.87	154.15	154.42	4.10
4.20	154.42	154.70	154.98	155.26	155.53	155.81	156.09	156.37	156.64	156.92	157.20	4.20
4.30	157.20	157.48	157.75	158.03	158.31	158.58	158.86	159.14	159.41	159.69	159.97	4.30
4.40	159.97	160.24	160.52	160.80	161.07	161.35	161.63	161.90	162.18	162.45	162.73	4.40
4.50	162.73	163.01	163.28	163.56	163.83	164.11	164.38	164.66	164.94	165.21	165.49	4.50
4.60	165.49	165.76	166.04	166.31	166.59	166.86	167.14	167.41	167.69	167.96	168.24	4.60
4.70	168.24	168.51	168.79	169.06	169.34	169.61	169.89	170.16	170.44	170.71	170.98	4.70
4.80	170.98	171.26	171.53	171.81	172.08	172.35	172.63	172.90	173.18	173.45	173.72	4.80
4.90	173.72	174.00	174.27	174.55	174.82	175.09	175.37	175.64	175.91	176.19	176.46	4.90
5.00	176.46	176.73	177.01	177.28	177.55	177.82	178.10	178.37	178.64	178.92	179.19	5.00
5.10	179.19	179.46	179.73	180.01	180.28	180.55	180.82	181.10	181.37	181.64	181.91	5.10
5.20	181.91	182.19	182.46	182.73	183.00	183.27	183.55	183.82	184.09	184.36	184.63	5.20
5.30	184.63	184.90	185.18	185.45	185.72	185.99	186.26	186.53	186.80	187.07	187.35	5.30
5.40	187.35	187.62	187.89	188.16	188.43	188.70	188.97	189.24	189.51	189.78	190.05	5.40
5.50	190.05	190.33	190.60	190.87	191.14	191.41	191.68	191.95	192.22	192.49	192.76	5.50
5.60	192.76	193.03	193.30	193.57	193.84	194.11	194.38	194.65	194.92	195.19	195.46	5.60
5.70	195.46	195.73	196.00	196.27	196.53	196.80	197.07	197.34	197.61	197.88	198.15	5.70
5.80	198.15	198.42	198.69	198.96	199.23	199.50	199.76	200.03	200.30	200.57	200.84	5.80
5.90	200.84	201.11	201.38	201.64	201.91	202.18	202.45	202.72	202.99	203.25	203.52	5.90
6.00	203.52	203.79	204.06	204.33	204.59	204.86	205.13	205.40	205.67	205.93	206.20	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
6.00	203.52	203.79	204.06	204.33	204.59	204.86	205.13	205.40	205.67	205.93	206.20	6.00
6.10	206.20	206.47	206.74	207.00	207.27	207.54	207.81	208.07	208.34	208.61	208.88	6.10
6.20	208.88	209.14	209.41	209.68	209.94	210.21	210.48	210.74	211.01	211.28	211.55	6.20
6.30	211.55	211.81	212.08	212.35	212.61	212.88	213.14	213.41	213.68	213.94	214.21	6.30
6.40	214.21	214.48	214.74	215.01	215.27	215.54	215.81	216.07	216.34	216.60	216.87	6.40
6.50	216.87	217.14	217.40	217.67	217.93	218.20	218.46	218.73	218.99	219.26	219.53	6.50
6.60	219.53	219.79	220.06	220.32	220.59	220.85	221.12	221.38	221.65	221.91	222.18	6.60
6.70	222.18	222.44	222.71	222.97	223.24	223.50	223.76	224.03	224.29	224.56	224.82	6.70
6.80	224.82	225.09	225.35	225.62	225.88	226.14	226.41	226.67	226.94	227.20	227.46	6.80
6.90	227.46	227.73	227.99	228.26	228.52	228.78	229.05	229.31	229.57	229.84	230.10	6.90
7.00	230.10	230.37	230.63	230.89	231.16	231.42	231.68	231.95	232.21	232.47	232.74	7.00
7.10	232.74	233.00	233.26	233.52	233.79	234.05	234.31	234.58	234.84	235.10	235.36	7.10
7.20	235.36	235.63	235.89	236.15	236.41	236.68	236.94	237.20	237.46	237.73	237.99	7.20
7.30	237.99	238.25	238.51	238.78	239.04	239.30	239.56	239.82	240.09	240.35	240.61	7.30
7.40	240.61	240.87	241.13	241.39	241.66	241.92	242.18	242.44	242.70	242.96	243.23	7.40
7.50	243.23	243.49	243.75	244.01	244.27	244.53	244.79	245.05	245.32	245.58	245.84	7.50
7.60	245.84	246.10	246.36	246.62	246.88	247.14	247.40	247.66	247.92	248.18	248.45	7.60
7.70	248.45	248.71	248.97	249.23	249.49	249.75	250.01	250.27	250.53	250.79	251.05	7.70
7.80	251.05	251.31	251.57	251.83	252.09	252.35	252.61	252.87	253.13	253.39	253.65	7.80
7.90	253.65	253.91	254.17	254.43	254.69	254.95	255.21	255.47	255.73	255.99	256.25	7.90
8.00	256.25	256.50	256.76	257.02	257.28	257.54	257.80	258.06	258.32	258.58	258.84	8.00
8.10	258.84	259.10	259.36	259.61	259.87	260.13	260.39	260.65	260.91	261.17	261.43	8.10
8.20	261.43	261.68	261.94	262.20	262.46	262.72	262.98	263.23	263.49	263.75	264.01	8.20
8.30	264.01	264.27	264.53	264.78	265.04	265.30	265.56	265.82	266.07	266.33	266.59	8.30
8.40	266.59	266.85	267.11	267.36	267.62	267.88	268.14	268.39	268.65	268.91	269.17	8.40
8.50	269.17	269.42	269.68	269.94	270.20	270.45	270.71	270.97	271.23	271.48	271.74	8.50
8.60	271.74	272.00	272.25	272.51	272.77	273.03	273.28	273.54	273.80	274.05	274.31	8.60
8.70	274.31	274.57	274.82	275.08	275.34	275.59	275.85	276.11	276.36	276.62	276.88	8.70
8.80	276.88	277.13	277.39	277.64	277.90	278.16	278.41	278.67	278.93	279.18	279.44	8.80
8.90	279.44	279.69	279.95	280.21	280.46	280.72	280.97	281.23	281.48	281.74	282.00	8.90
9.00	282.00	282.25	282.51	282.76	283.02	283.27	283.53	283.78	284.04	284.30	284.55	9.00
9.10	284.55	284.81	285.06	285.32	285.57	285.83	286.08	286.34	286.59	286.85	287.10	9.10
9.20	287.10	287.36	287.61	287.87	288.12	288.38	288.63	288.89	289.14	289.40	289.65	9.20
9.30	289.65	289.91	290.16	290.41	290.67	290.92	291.18	291.43	291.69	291.94	292.20	9.30
9.40	292.20	292.45	292.70	292.96	293.21	293.47	293.72	293.97	294.23	294.48	294.74	9.40
9.50	294.74	294.99	295.24	295.50	295.75	296.01	296.26	296.51	296.77	297.02	297.27	9.50
9.60	297.27	297.53	297.78	298.04	298.29	298.54	298.80	299.05	299.30	299.56	299.81	9.60
9.70	299.81	300.06	300.32	300.57	300.82	301.08	301.33	301.58	301.83	302.09	302.34	9.70
9.80	302.34	302.59	302.85	303.10	303.35	303.60	303.86	304.11	304.36	304.62	304.87	9.80
9.90	304.87	305.12	305.37	305.63	305.88	306.13	306.38	306.64	306.89	307.14	307.39	9.90
10.00	307.39	307.65	307.90	308.15	308.40	308.65	308.91	309.16	309.41	309.66	309.92	10.00
10.10	309.92	310.17	310.42	310.67	310.92	311.17	311.43	311.68	311.93	312.18	312.43	10.10
10.20	312.43	312.69	312.94	313.19	313.44	313.69	313.94	314.19	314.45	314.70	314.95	10.20
10.30	314.95	315.20	315.45	315.70	315.95	316.21	316.46	316.71	316.96	317.21	317.46	10.30
10.40	317.46	317.71	317.96	318.21	318.47	318.72	318.97	319.22	319.47	319.72	319.97	10.40
10.50	319.97	320.22	320.47	320.72	320.97	321.22	321.47	321.73	321.98	322.23	322.48	10.50
10.60	322.48	322.73	322.98	323.23	323.48	323.73	323.98	324.23	324.48	324.73	324.98	10.60
10.70	324.98	325.23	325.48	325.73	325.98	326.23	326.48	326.73	326.98	327.23	327.48	10.70
10.80	327.48	327.73	327.98	328.23	328.48	328.73	328.98	329.23	329.48	329.73	329.98	10.80
10.90	329.98	330.23	330.48	330.73	330.98	331.23	331.48	331.72	331.97	332.22	332.47	10.90
11.00	332.47	332.72	332.97	333.22	333.47	333.72	333.97	334.22	334.47	334.72	334.96	11.00
11.10	334.96	335.21	335.46	335.71	335.96	336.21	336.46	336.71	336.96	337.20	337.45	11.10
11.20	337.45	337.70	337.95	338.20	338.45	338.70	338.95	339.19	339.44	339.69	339.94	11.20
11.30	339.94	340.19	340.44	340.68	340.93	341.18	341.43	341.68	341.93	342.17	342.42	11.30
11.40	342.42	342.67	342.92	343.17	343.42	343.66	343.91	344.16	344.41	344.66	344.90	11.40
11.50	344.90	345.15	345.40	345.65	345.89	346.14	346.39	346.64	346.89	347.13	347.38	11.50
11.60	347.38	347.63	347.88	348.12	348.37	348.62	348.87	349.11	349.36	349.61	349.86	11.60
11.70	349.86	350.10	350.35	350.60	350.85	351.09	351.34	351.59	351.83	352.08	352.33	11.70
11.80	352.33	352.58	352.82	353.07	353.32	353.56	353.81	354.06	354.30	354.55	354.80	11.80
11.90	354.80	355.05	355.29	355.54	355.79	356.03	356.28	356.53	356.77	357.02	357.27	11.90
12.00	357.27	357.51	357.76	358.01	358.25	358.50	358.74	358.99	359.24	359.48	359.73	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. *Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
12.00	357.27	357.51	357.76	358.01	358.25	358.50	358.74	358.99	359.24	359.48	359.73	12.00
12.10	359.73	359.98	360.22	360.47	360.72	360.96	361.21	361.45	361.70	361.95	362.19	12.10
12.20	362.19	362.44	362.68	362.93	363.18	363.42	363.67	363.91	364.16	364.41	364.65	12.20
12.30	364.65	364.90	365.14	365.39	365.63	365.88	366.13	366.37	366.62	366.86	367.11	12.30
12.40	367.11	367.35	367.60	367.85	368.09	368.34	368.58	368.83	369.07	369.32	369.56	12.40
12.50	369.56	369.81	370.05	370.30	370.54	370.79	371.03	371.28	371.53	371.77	372.02	12.50
12.60	372.02	372.26	372.51	372.75	373.00	373.24	373.49	373.73	373.98	374.22	374.47	12.60
12.70	374.47	374.71	374.95	375.20	375.44	375.69	375.93	376.18	376.42	376.67	376.91	12.70
12.80	376.91	377.16	377.40	377.65	377.89	378.14	378.38	378.62	378.87	379.11	379.36	12.80
12.90	379.36	379.60	379.85	380.09	380.33	380.58	380.82	381.07	381.31	381.56	381.80	12.90
13.00	381.80	382.04	382.29	382.53	382.78	383.02	383.26	383.51	383.75	384.00	384.24	13.00
13.10	384.24	384.48	384.73	384.97	385.22	385.46	385.70	385.95	386.19	386.43	386.68	13.10
13.20	386.68	386.92	387.17	387.41	387.65	387.90	388.14	388.38	388.63	388.87	389.11	13.20
13.30	389.11	389.36	389.60	389.84	390.09	390.33	390.57	390.82	391.06	391.30	391.55	13.30
13.40	391.55	391.79	392.03	392.28	392.52	392.76	393.01	393.25	393.49	393.73	393.98	13.40
13.50	393.98	394.22	394.46	394.71	394.95	395.19	395.44	395.68	395.92	396.16	396.41	13.50
13.60	396.41	396.65	396.89	397.13	397.38	397.62	397.86	398.11	398.35	398.59	398.83	13.60
13.70	398.83	399.08	399.32	399.56	399.80	400.05	400.29	400.53	400.77	401.02	401.26	13.70
13.80	401.26	401.50	401.74	401.98	402.23	402.47	402.71	402.95	403.20	403.44	403.68	13.80
13.90	403.68	403.92	404.16	404.41	404.65	404.89	405.13	405.37	405.62	405.86	406.10	13.90
14.00	406.10	406.34	406.58	406.83	407.07	407.31	407.55	407.79	408.03	408.28	408.52	14.00
14.10	408.52	408.76	409.00	409.24	409.48	409.73	409.97	410.21	410.45	410.69	410.93	14.10
14.20	410.93	411.18	411.42	411.66	411.90	412.14	412.38	412.62	412.87	413.11	413.35	14.20
14.30	413.35	413.59	413.83	414.07	414.31	414.55	414.80	415.04	415.28	415.52	415.76	14.30
14.40	415.76	416.00	416.24	416.48	416.72	416.96	417.21	417.45	417.69	417.93	418.17	14.40
14.50	418.17	418.41	418.65	418.89	419.13	419.37	419.61	419.85	420.10	420.34	420.58	14.50
14.60	420.58	420.82	421.06	421.30	421.54	421.78	422.02	422.26	422.50	422.74	422.98	14.60
14.70	422.98	423.22	423.46	423.70	423.94	424.18	424.43	424.67	424.91	425.15	425.39	14.70
14.80	425.39	425.63	425.87	426.11	426.35	426.59	426.83	427.07	427.31	427.55	427.79	14.80
14.90	427.79	428.03	428.27	428.51	428.75	428.99	429.23	429.47	429.71	429.95	430.19	14.90
15.00	430.19	430.43	430.67	430.91	431.15	431.39	431.63	431.87	432.11	432.35	432.59	15.00
15.10	432.59	432.83	433.07	433.31	433.54	433.78	434.02	434.26	434.50	434.74	434.98	15.10
15.20	434.98	435.22	435.46	435.70	435.94	436.18	436.42	436.66	436.90	437.14	437.38	15.20
15.30	437.38	437.62	437.86	438.09	438.33	438.57	438.81	439.05	439.29	439.53	439.77	15.30
15.40	439.77	440.01	440.25	440.49	440.73	440.96	441.20	441.44	441.68	441.92	442.16	15.40
15.50	442.16	442.40	442.64	442.88	443.11	443.35	443.59	443.83	444.07	444.31	444.55	15.50
15.60	444.55	444.79	445.03	445.26	445.50	445.74	445.98	446.22	446.46	446.70	446.93	15.60
15.70	446.93	447.17	447.41	447.65	447.89	448.13	448.37	448.60	448.84	449.08	449.32	15.70
15.80	449.32	449.56	449.80	450.03	450.27	450.51	450.75	450.99	451.23	451.46	451.70	15.80
15.90	451.70	451.94	452.18	452.42	452.66	452.89	453.13	453.37	453.61	453.85	454.08	15.90
16.00	454.08	454.32	454.56	454.80	455.04	455.27	455.51	455.75	455.99	456.23	456.46	16.00
16.10	456.46	456.70	456.94	457.18	457.42	457.65	457.89	458.13	458.37	458.60	458.84	16.10
16.20	458.84	459.08	459.32	459.56	459.79	460.03	460.27	460.51	460.74	460.98	461.22	16.20
16.30	461.22	461.46	461.69	461.93	462.17	462.41	462.64	462.88	463.12	463.36	463.59	16.30
16.40	463.59	463.83	464.07	464.30	464.54	464.78	465.02	465.25	465.49	465.73	465.97	16.40
16.50	465.97	466.20	466.44	466.68	466.91	467.15	467.39	467.63	467.86	468.10	468.34	16.50
16.60	468.34	468.57	468.81	469.05	469.29	469.52	469.76	470.00	470.23	470.47	470.71	16.60
16.70	470.71	470.94	471.18	471.42	471.65	471.89	472.13	472.36	472.60	472.84	473.07	16.70
16.80	473.07	473.31	473.55	473.78	474.02	474.26	474.49	474.73	474.97	475.20	475.44	16.80
16.90	475.44	475.68	475.91	476.15	476.39	476.62	476.86	477.10	477.33	477.57	477.81	16.90
17.00	477.81	478.04	478.28	478.51	478.75	478.99	479.22	479.46	479.70	479.93	480.17	17.00
17.10	480.17	480.41	480.64	480.88	481.11	481.35	481.59	481.82	482.06	482.29	482.53	17.10
17.20	482.53	482.77	483.00	483.24	483.47	483.71	483.95	484.18	484.42	484.65	484.89	17.20
17.30	484.89	485.13	485.36	485.60	485.83	486.07	486.31	486.54	486.78	487.01	487.25	17.30
17.40	487.25	487.48	487.72	487.96	488.19	488.43	488.66	488.90	489.13	489.37	489.61	17.40
17.50	489.61	489.84	490.08	490.31	490.55	490.78	491.02	491.25	491.49	491.73	491.96	17.50
17.60	491.96	492.20	492.43	492.67	492.90	493.14	493.37	493.61	493.84	494.08	494.32	17.60
17.70	494.32	494.55	494.79	495.02	495.26	495.49	495.73	495.96	496.20	496.43	496.67	17.70
17.80	496.67	496.90	497.14	497.37	497.61	497.84	498.08	498.31	498.55	498.78	499.02	17.80
17.90	499.02	499.25	499.49	499.72	499.96	500.19	500.43	500.66	500.90	501.13	501.37	17.90
18.00	501.37	501.60	501.84	502.07	502.31	502.54	502.78	503.01	503.25	503.48	503.72	18.00

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
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TABLE A5.2.2. Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
18.00	501.37	501.60	501.84	502.07	502.31	502.54	502.78	503.01	503.25	503.48	503.72	18.00
18.10	503.72	503.95	504.19	504.42	504.65	504.89	505.12	505.36	505.59	505.83	506.06	18.10
18.20	506.06	506.30	506.53	506.77	507.00	507.24	507.47	507.70	507.94	508.17	508.41	18.20
18.30	508.41	508.64	508.88	509.11	509.35	509.58	509.81	510.05	510.28	510.52	510.75	18.30
18.40	510.75	510.99	511.22	511.45	511.69	511.92	512.16	512.39	512.63	512.86	513.09	18.40
18.50	513.09	513.33	513.56	513.80	514.03	514.26	514.50	514.73	514.97	515.20	515.43	18.50
18.60	515.43	515.67	515.90	516.14	516.37	516.60	516.84	517.07	517.31	517.54	517.77	18.60
18.70	517.77	518.01	518.24	518.48	518.71	518.94	519.18	519.41	519.65	519.88	520.11	18.70
18.80	520.11	520.35	520.58	520.81	521.05	521.28	521.52	521.75	521.98	522.22	522.45	18.80
18.90	522.45	522.68	522.92	523.15	523.38	523.62	523.85	524.08	524.32	524.55	524.79	18.90
19.00	524.79	525.02	525.25	525.49	525.72	525.95	526.19	526.42	526.65	526.89	527.12	19.00
19.10	527.12	527.35	527.59	527.82	528.05	528.29	528.52	528.75	528.99	529.22	529.45	19.10
19.20	529.45	529.69	529.92	530.15	530.39	530.62	530.85	531.08	531.32	531.55	531.78	19.20
19.30	531.78	532.02	532.25	532.48	532.72	532.95	533.18	533.42	533.65	533.88	534.11	19.30
19.40	534.11	534.35	534.58	534.81	535.05	535.28	535.51	535.75	535.98	536.21	536.44	19.40
19.50	536.44	536.68	536.91	537.14	537.37	537.61	537.84	538.07	538.31	538.54	538.77	19.50
19.60	538.77	539.00	539.24	539.47	539.70	539.93	540.17	540.40	540.63	540.87	541.10	19.60
19.70	541.10	541.33	541.56	541.80	542.03	542.26	542.49	542.73	542.96	543.19	543.42	19.70
19.80	543.42	543.66	543.89	544.12	544.35	544.59	544.82	545.05	545.28	545.52	545.75	19.80
19.90	545.75	545.98	546.21	546.44	546.68	546.91	547.14	547.37	547.61	547.84	548.07	19.90
20.00	548.07	548.30	548.53	548.77	549.00	549.23	549.46	549.70	549.93	550.16	550.39	20.00
20.10	550.39	550.62	550.86	551.09	551.32	551.55	551.78	552.02	552.25	552.48	552.71	20.10
20.20	552.71	552.94	553.18	553.41	553.64	553.87	554.10	554.34	554.57	554.80	555.03	20.20
20.30	555.03	555.26	555.50	555.73	555.96	556.19	556.42	556.65	556.89	557.12	557.35	20.30
20.40	557.35	557.58	557.81	558.05	558.28	558.51	558.74	558.97	559.20	559.44	559.67	20.40
20.50	559.67	559.90	560.13	560.36	560.59	560.82	561.06	561.29	561.52	561.75	561.98	20.50
20.60	561.98	562.21	562.45	562.68	562.91	563.14	563.37	563.60	563.83	564.07	564.30	20.60
20.70	564.30	564.53	564.76	564.99	565.22	565.45	565.69	565.92	566.15	566.38	566.61	20.70
20.80	566.61	566.84	567.07	567.30	567.54	567.77	568.00	568.23	568.46	568.69	568.92	20.80
20.90	568.92	569.15	569.39	569.62	569.85	570.08	570.31	570.54	570.77	571.00	571.23	20.90
21.00	571.23	571.47	571.70	571.93	572.16	572.39	572.62	572.85	573.08	573.31	573.54	21.00
21.10	573.54	573.78	574.01	574.24	574.47	574.70	574.93	575.16	575.39	575.62	575.85	21.10
21.20	575.85	576.08	576.32	576.55	576.78	577.01	577.24	577.47	577.70	577.93	578.16	21.20
21.30	578.16	578.39	578.62	578.85	579.08	579.32	579.55	579.78	580.01	580.24	580.47	21.30
21.40	580.47	580.70	580.93	581.16	581.39	581.62	581.85	582.08	582.31	582.54	582.77	21.40
21.50	582.77	583.01	583.24	583.47	583.70	583.93	584.16	584.39	584.62	584.85	585.08	21.50
21.60	585.08	585.31	585.54	585.77	586.00	586.23	586.46	586.69	586.92	587.15	587.38	21.60
21.70	587.38	587.61	587.84	588.07	588.30	588.53	588.76	589.00	589.23	589.46	589.69	21.70
21.80	589.69	589.92	590.15	590.38	590.61	590.84	591.07	591.30	591.53	591.76	591.99	21.80
21.90	591.99	592.22	592.45	592.68	592.91	593.14	593.37	593.60	593.83	594.06	594.29	21.90
22.00	594.29	594.52	594.75	594.98	595.21	595.44	595.67	595.90	596.13	596.36	596.59	22.00
22.10	596.59	596.82	597.05	597.28	597.51	597.74	597.97	598.20	598.43	598.66	598.89	22.10
22.20	598.89	599.12	599.35	599.58	599.81	600.04	600.27	600.50	600.72	600.95	601.18	22.20
22.30	601.18	601.41	601.64	601.87	602.10	602.33	602.56	602.79	603.02	603.25	603.48	22.30
22.40	603.48	603.71	603.94	604.17	604.40	604.63	604.86	605.09	605.32	605.55	605.78	22.40
22.50	605.78	606.01	606.24	606.47	606.69	606.92	607.15	607.38	607.61	607.84	608.07	22.50
22.60	608.07	608.30	608.53	608.76	608.99	609.22	609.45	609.68	609.91	610.14	610.37	22.60
22.70	610.37	610.59	610.82	611.05	611.28	611.51	611.74	611.97	612.20	612.43	612.66	22.70
22.80	612.66	612.89	613.12	613.35	613.58	613.80	614.03	614.26	614.49	614.72	614.95	22.80
22.90	614.95	615.18	615.41	615.64	615.87	616.10	616.32	616.55	616.78	617.01	617.24	22.90
23.00	617.24	617.47	617.70	617.93	618.16	618.39	618.62	618.84	619.07	619.30	619.53	23.00
23.10	619.53	619.76	619.99	620.22	620.45	620.68	620.90	621.13	621.36	621.59	621.82	23.10
23.20	621.82	622.05	622.28	622.51	622.74	622.96	623.19	623.42	623.65	623.88	624.11	23.20
23.30	624.11	624.34	624.57	624.79	625.02	625.25	625.48	625.71	625.94	626.17	626.40	23.30
23.40	626.40	626.62	626.85	627.08	627.31	627.54	627.77	628.00	628.23	628.45	628.68	23.40
23.50	628.68	628.91	629.14	629.37	629.60	629.83	630.05	630.28	630.51	630.74	630.97	23.50
23.60	630.97	631.20	631.43	631.65	631.88	632.11	632.34	632.57	632.80	633.02	633.25	23.60
23.70	633.25	633.48	633.71	633.94	634.17	634.39	634.62	634.85	635.08	635.31	635.54	23.70
23.80	635.54	635.76	635.99	636.22	636.45	636.68	636.91	637.13	637.36	637.59	637.82	23.80
23.90	637.82	638.05	638.28	638.50	638.73	638.96	639.19	639.42	639.65	639.87	640.10	23.90
24.00	640.10	640.33	640.56	640.79	641.01	641.24	641.47	641.70	641.93	642.15	642.38	24.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
24.00	640.10	640.33	640.56	640.79	641.01	641.24	641.47	641.70	641.93	642.15	642.38	24.00
24.10	642.38	642.61	642.84	643.07	643.30	643.52	643.75	643.98	644.21	644.44	644.66	24.10
24.20	644.66	644.89	645.12	645.35	645.58	645.80	646.03	646.26	646.49	646.72	646.94	24.20
24.30	646.94	647.17	647.40	647.63	647.85	648.08	648.31	648.54	648.77	648.99	649.22	24.30
24.40	649.22	649.45	649.68	649.91	650.13	650.36	650.59	650.82	651.04	651.27	651.50	24.40
24.50	651.50	651.73	651.96	652.18	652.41	652.64	652.87	653.09	653.32	653.55	653.78	24.50
24.60	653.78	654.00	654.23	654.46	654.69	654.92	655.14	655.37	655.60	655.83	656.05	24.60
24.70	656.05	656.28	656.51	656.74	656.96	657.19	657.42	657.65	657.87	658.10	658.33	24.70
24.80	658.33	658.56	658.78	659.01	659.24	659.47	659.69	659.92	660.15	660.38	660.60	24.80
24.90	660.60	660.83	661.06	661.29	661.51	661.74	661.97	662.20	662.42	662.65	662.88	24.90
25.00	662.88	663.11	663.33	663.56	663.79	664.02	664.24	664.47	664.70	664.92	665.15	25.00
25.10	665.15	665.38	665.61	665.83	666.06	666.29	666.52	666.74	666.97	667.20	667.42	25.10
25.20	667.42	667.65	667.88	668.11	668.33	668.56	668.79	669.01	669.24	669.47	669.70	25.20
25.30	669.70	669.92	670.15	670.38	670.60	670.83	671.06	671.29	671.51	671.74	671.97	25.30
25.40	671.97	672.19	672.42	672.65	672.88	673.10	673.33	673.56	673.78	674.01	674.24	25.40
25.50	674.24	674.46	674.69	674.92	675.15	675.37	675.60	675.83	676.05	676.28	676.51	25.50
25.60	676.51	676.73	676.96	677.19	677.41	677.64	677.87	678.10	678.32	678.55	678.78	25.60
25.70	678.78	679.00	679.23	679.46	679.68	679.91	680.14	680.36	680.59	680.82	681.04	25.70
25.80	681.04	681.27	681.50	681.72	681.95	682.18	682.40	682.63	682.86	683.08	683.31	25.80
25.90	683.31	683.54	683.77	683.99	684.22	684.45	684.67	684.90	685.13	685.35	685.58	25.90
26.00	685.58	685.81	686.03	686.26	686.48	686.71	686.94	687.16	687.39	687.62	687.84	26.00
26.10	687.84	688.07	688.30	688.52	688.75	688.98	689.20	689.43	689.66	689.88	690.11	26.10
26.20	690.11	690.34	690.56	690.79	691.02	691.24	691.47	691.70	691.92	692.15	692.37	26.20
26.30	692.37	692.60	692.83	693.05	693.28	693.51	693.73	693.96	694.19	694.41	694.64	26.30
26.40	694.64	694.86	695.09	695.32	695.54	695.77	696.00	696.22	696.45	696.68	696.90	26.40
26.50	696.90	697.13	697.35	697.58	697.81	698.03	698.26	698.49	698.71	698.94	699.16	26.50
26.60	699.16	699.39	699.62	699.84	700.07	700.30	700.52	700.75	700.97	701.20	701.43	26.60
26.70	701.43	701.65	701.88	702.11	702.33	702.56	702.78	703.01	703.24	703.46	703.69	26.70
26.80	703.69	703.91	704.14	704.37	704.59	704.82	705.04	705.27	705.50	705.72	705.95	26.80
26.90	705.95	706.17	706.40	706.63	706.85	707.08	707.30	707.53	707.76	707.98	708.21	26.90
27.00	708.21	708.43	708.66	708.89	709.11	709.34	709.56	709.79	710.02	710.24	710.47	27.00
27.10	710.47	710.69	710.92	711.15	711.37	711.60	711.82	712.05	712.28	712.50	712.73	27.10
27.20	712.73	712.95	713.18	713.40	713.63	713.86	714.08	714.31	714.53	714.76	714.99	27.20
27.30	714.99	715.21	715.44	715.66	715.89	716.11	716.34	716.57	716.79	717.02	717.24	27.30
27.40	717.24	717.47	717.69	717.92	718.15	718.37	718.60	718.82	719.05	719.27	719.50	27.40
27.50	719.50	719.73	719.95	720.18	720.40	720.63	720.85	721.08	721.31	721.53	721.76	27.50
27.60	721.76	721.98	722.21	722.43	722.66	722.88	723.11	723.34	723.56	723.79	724.01	27.60
27.70	724.01	724.24	724.46	724.69	724.91	725.14	725.37	725.59	725.82	726.04	726.27	27.70
27.80	726.27	726.49	726.72	726.94	727.17	727.40	727.62	727.85	728.07	728.30	728.52	27.80
27.90	728.52	728.75	728.97	729.20	729.42	729.65	729.88	730.10	730.33	730.55	730.78	27.90
28.00	730.78	731.00	731.23	731.45	731.68	731.90	732.13	732.35	732.58	732.80	733.03	28.00
28.10	733.03	733.26	733.48	733.71	733.93	734.16	734.38	734.61	734.83	735.06	735.28	28.10
28.20	735.28	735.51	735.73	735.96	736.18	736.41	736.63	736.86	737.09	737.31	737.54	28.20
28.30	737.54	737.76	737.99	738.21	738.44	738.66	738.89	739.11	739.34	739.56	739.79	28.30
28.40	739.79	740.01	740.24	740.46	740.69	740.91	741.14	741.36	741.59	741.81	742.04	28.40
28.50	742.04	742.26	742.49	742.71	742.94	743.16	743.39	743.61	743.84	744.06	744.29	28.50
28.60	744.29	744.51	744.74	744.97	745.19	745.42	745.64	745.87	746.09	746.32	746.54	28.60
28.70	746.54	746.77	746.99	747.22	747.44	747.67	747.89	748.12	748.34	748.57	748.79	28.70
28.80	748.79	749.01	749.24	749.46	749.69	749.91	750.14	750.36	750.59	750.81	751.04	28.80
28.90	751.04	751.26	751.49	751.71	751.94	752.16	752.39	752.61	752.84	753.06	753.29	28.90
29.00	753.29	753.51	753.74	753.96	754.19	754.41	754.64	754.86	755.09	755.31	755.54	29.00
29.10	755.54	755.76	755.99	756.21	756.44	756.66	756.88	757.11	757.33	757.56	757.78	29.10
29.20	757.78	758.01	758.23	758.46	758.68	758.91	759.13	759.36	759.58	759.81	760.03	29.20
29.30	760.03	760.26	760.48	760.71	760.93	761.15	761.38	761.60	761.83	762.05	762.28	29.30
29.40	762.28	762.50	762.73	762.95	763.18	763.40	763.63	763.85	764.08	764.30	764.52	29.40
29.50	764.52	764.75	764.97	765.20	765.42	765.65	765.87	766.10	766.32	766.55	766.77	29.50
29.60	766.77	766.99	767.22	767.44	767.67	767.89	768.12	768.34	768.57	768.79	769.02	29.60
29.70	769.02	769.24	769.46	769.69	769.91	770.14	770.36	770.59	770.81	771.04	771.26	29.70
29.80	771.26	771.48	771.71	771.93	772.16	772.38	772.61	772.83	773.06	773.28	773.50	29.80
29.90	773.50	773.73	773.95	774.18	774.40	774.63	774.85	775.08	775.30	775.52	775.75	29.90
30.00	775.75	775.97	776.20	776.42	776.65	776.87	777.10	777.32	777.54	777.77	777.99	30.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. *Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
30.00	775.75	775.97	776.20	776.42	776.65	776.87	777.10	777.32	777.54	777.77	777.99	30.00
30.10	777.99	778.22	778.44	778.67	778.89	779.11	779.34	779.56	779.79	780.01	780.24	30.10
30.20	780.24	780.46	780.68	780.91	781.13	781.36	781.58	781.81	782.03	782.25	782.48	30.20
30.30	782.48	782.70	782.93	783.15	783.38	783.60	783.82	784.05	784.27	784.50	784.72	30.30
30.40	784.72	784.94	785.17	785.39	785.62	785.84	786.07	786.29	786.51	786.74	786.96	30.40
30.50	786.96	787.19	787.41	787.63	787.86	788.08	788.31	788.53	788.76	788.98	789.20	30.50
30.60	789.20	789.43	789.65	789.88	790.10	790.32	790.55	790.77	791.00	791.22	791.44	30.60
30.70	791.44	791.67	791.89	792.12	792.34	792.56	792.79	793.01	793.24	793.46	793.69	30.70
30.80	793.69	793.91	794.13	794.36	794.58	794.81	795.03	795.25	795.48	795.70	795.93	30.80
30.90	795.93	796.15	796.37	796.60	796.82	797.05	797.27	797.49	797.72	797.94	798.17	30.90
31.00	798.17	798.39	798.61	798.84	799.06	799.28	799.51	799.73	799.96	800.18	800.40	31.00
31.10	800.40	800.63	800.85	801.08	801.30	801.52	801.75	801.97	802.20	802.42	802.64	31.10
31.20	802.64	802.87	803.09	803.32	803.54	803.76	803.99	804.21	804.43	804.66	804.88	31.20
31.30	804.88	805.11	805.33	805.55	805.78	806.00	806.22	806.45	806.67	806.90	807.12	31.30
31.40	807.12	807.34	807.57	807.79	808.02	808.24	808.46	808.69	808.91	809.13	809.36	31.40
31.50	809.36	809.58	809.81	810.03	810.25	810.48	810.70	810.92	811.15	811.37	811.60	31.50
31.60	811.60	811.82	812.04	812.27	812.49	812.71	812.94	813.16	813.39	813.61	813.83	31.60
31.70	813.83	814.06	814.28	814.50	814.73	814.95	815.17	815.40	815.62	815.85	816.07	31.70
31.80	816.07	816.29	816.52	816.74	816.96	817.19	817.41	817.64	817.86	818.08	818.31	31.80
31.90	818.31	818.53	818.75	818.98	819.20	819.42	819.65	819.87	820.09	820.32	820.54	31.90
32.00	820.54	820.77	820.99	821.21	821.44	821.66	821.88	822.11	822.33	822.55	822.78	32.00
32.10	822.78	823.00	823.22	823.45	823.67	823.90	824.12	824.34	824.57	824.79	825.01	32.10
32.20	825.01	825.24	825.46	825.68	825.91	826.13	826.35	826.58	826.80	827.02	827.25	32.20
32.30	827.25	827.47	827.70	827.92	828.14	828.37	828.59	828.81	829.04	829.26	829.48	32.30
32.40	829.48	829.71	829.93	830.15	830.38	830.60	830.82	831.05	831.27	831.49	831.72	32.40
32.50	831.72	831.94	832.16	832.39	832.61	832.83	833.06	833.28	833.50	833.73	833.95	32.50
32.60	833.95	834.18	834.40	834.62	834.85	835.07	835.29	835.52	835.74	835.96	836.19	32.60
32.70	836.19	836.41	836.63	836.86	837.08	837.30	837.53	837.75	837.97	838.20	838.42	32.70
32.80	838.42	838.64	838.87	839.09	839.31	839.54	839.76	839.99	840.21	840.43	840.65	32.80
32.90	840.65	840.88	841.10	841.32	841.55	841.77	841.99	842.22	842.44	842.66	842.89	32.90
33.00	842.89	843.11	843.33	843.56	843.78	844.00	844.23	844.45	844.67	844.89	845.12	33.00
33.10	845.12	845.34	845.56	845.79	846.01	846.23	846.46	846.68	846.90	847.13	847.35	33.10
33.20	847.35	847.57	847.80	848.02	848.24	848.47	848.69	848.91	849.14	849.36	849.58	33.20
33.30	849.58	849.81	850.03	850.25	850.48	850.70	850.92	851.14	851.37	851.59	851.81	33.30
33.40	851.81	852.04	852.26	852.48	852.71	852.93	853.15	853.38	853.60	853.82	854.05	33.40
33.50	854.05	854.27	854.49	854.72	854.94	855.16	855.38	855.61	855.83	856.05	856.28	33.50
33.60	856.28	856.50	856.72	856.95	857.17	857.39	857.62	857.84	858.06	858.29	858.51	33.60
33.70	858.51	858.73	858.95	859.18	859.40	859.62	859.85	860.07	860.29	860.52	860.74	33.70
33.80	860.74	860.96	861.19	861.41	861.63	861.85	862.08	862.30	862.52	862.75	862.97	33.80
33.90	862.97	863.19	863.42	863.64	863.86	864.09	864.31	864.53	864.75	864.98	865.20	33.90
34.00	865.20	865.42	865.65	865.87	866.09	866.32	866.54	866.76	866.98	867.21	867.43	34.00
34.10	867.43	867.65	867.88	868.10	868.32	868.55	868.77	868.99	869.21	869.44	869.66	34.10
34.20	869.66	869.88	870.11	870.33	870.55	870.78	871.00	871.22	871.44	871.67	871.89	34.20
34.30	871.89	872.11	872.34	872.56	872.78	873.00	873.23	873.45	873.67	873.90	874.12	34.30
34.40	874.12	874.34	874.57	874.79	875.01	875.23	875.46	875.68	875.90	876.13	876.35	34.40
34.50	876.35	876.57	876.79	877.02	877.24	877.46	877.69	877.91	878.13	878.35	878.58	34.50
34.60	878.58	878.80	879.02	879.25	879.47	879.69	879.91	880.14	880.36	880.58	880.81	34.60
34.70	880.81	881.03	881.25	881.47	881.70	881.92	882.14	882.37	882.59	882.81	883.03	34.70
34.80	883.03	883.26	883.48	883.70	883.93	884.15	884.37	884.59	884.82	885.04	885.26	34.80
34.90	885.26	885.49	885.71	885.93	886.15	886.38	886.60	886.82	887.05	887.27	887.49	34.90
35.00	887.49	887.71	887.94	888.16	888.38	888.61	888.83	889.05	889.27	889.50	889.72	35.00
35.10	889.72	889.94	890.17	890.39	890.61	890.83	891.06	891.28	891.50	891.72	891.95	35.10
35.20	891.95	892.17	892.39	892.62	892.84	893.06	893.28	893.51	893.73	893.95	894.17	35.20
35.30	894.17	894.40	894.62	894.84	895.07	895.29	895.51	895.73	895.96	896.18	896.40	35.30
35.40	896.40	896.63	896.85	897.07	897.29	897.52	897.74	897.96	898.18	898.41	898.63	35.40
35.50	898.63	898.85	899.08	899.30	899.52	899.74	899.97	900.19	900.41	900.63	900.86	35.50
35.60	900.86	901.08	901.30	901.53	901.75	901.97	902.19	902.42	902.64	902.86	903.08	35.60
35.70	903.08	903.31	903.53	903.75	903.97	904.20	904.42	904.64	904.87	905.09	905.31	35.70
35.80	905.31	905.53	905.76	905.98	906.20	906.42	906.65	906.87	907.09	907.31	907.54	35.80
35.90	907.54	907.76	907.98	908.21	908.43	908.65	908.87	909.10	909.32	909.54	909.76	35.90
36.00	909.76	909.99	910.21	910.43	910.65	910.88	911.10	911.32	911.55	911.77	911.99	36.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. *Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
36.00	909.76	909.99	910.21	910.43	910.65	910.88	911.10	911.32	911.55	911.77	911.99	36.00
36.10	911.99	912.21	912.44	912.66	912.88	913.10	913.33	913.55	913.77	913.99	914.22	36.10
36.20	914.22	914.44	914.66	914.88	915.11	915.33	915.55	915.78	916.00	916.22	916.44	36.20
36.30	916.44	916.67	916.89	917.11	917.33	917.56	917.78	918.00	918.22	918.45	918.67	36.30
36.40	918.67	918.89	919.11	919.34	919.56	919.78	920.00	920.23	920.45	920.67	920.89	36.40
36.50	920.89	921.12	921.34	921.56	921.79	922.01	922.23	922.45	922.68	922.90	923.12	36.50
36.60	923.12	923.34	923.57	923.79	924.01	924.23	924.46	924.68	924.90	925.12	925.35	36.60
36.70	925.35	925.57	925.79	926.01	926.24	926.46	926.68	926.90	927.13	927.35	927.57	36.70
36.80	927.57	927.79	928.02	928.24	928.46	928.68	928.91	929.13	929.36	929.59	929.80	36.80
36.90	929.80	930.02	930.24	930.47	930.69	930.91	931.13	931.36	931.58	931.80	932.02	36.90
37.00	932.02	932.25	932.47	932.69	932.91	933.14	933.36	933.58	933.80	934.03	934.25	37.00
37.10	934.25	934.47	934.69	934.92	935.14	935.36	935.58	935.81	936.03	936.25	936.47	37.10
37.20	936.47	936.70	936.92	937.14	937.36	937.59	937.81	938.03	938.25	938.48	938.70	37.20
37.30	938.70	938.92	939.14	939.37	939.59	939.81	940.03	940.26	940.48	940.70	940.92	37.30
37.40	940.92	941.15	941.37	941.59	941.81	942.04	942.26	942.48	942.70	942.93	943.15	37.40
37.50	943.15	943.37	943.59	943.82	944.04	944.26	944.48	944.71	944.93	945.15	945.37	37.50
37.60	945.37	945.60	945.82	946.04	946.26	946.49	946.71	946.93	947.15	947.38	947.60	37.60
37.70	947.60	947.82	948.04	948.27	948.49	948.71	948.93	949.16	949.38	949.60	949.82	37.70
37.80	949.82	950.05	950.27	950.49	950.71	950.94	951.16	951.38	951.60	951.83	952.05	37.80
37.90	952.05	952.27	952.49	952.72	952.94	953.16	953.38	953.60	953.83	954.05	954.27	37.90
38.00	954.27	954.49	954.72	954.94	955.16	955.38	955.61	955.83	956.05	956.27	956.50	38.00
38.10	956.50	956.72	956.94	957.16	957.39	957.61	957.83	958.05	958.28	958.50	958.72	38.10
38.20	958.72	958.94	959.17	959.39	959.61	959.83	960.06	960.28	960.50	960.72	960.95	38.20
38.30	960.95	961.17	961.39	961.61	961.84	962.06	962.28	962.50	962.73	962.95	963.17	38.30
38.40	963.17	963.39	963.62	963.84	964.06	964.28	964.51	964.73	964.95	965.17	965.39	38.40
38.50	965.39	965.62	965.84	966.06	966.28	966.51	966.73	966.95	967.17	967.40	967.62	38.50
38.60	967.62	967.84	968.06	968.29	968.51	968.73	968.95	969.18	969.40	969.62	969.84	38.60
38.70	969.84	970.07	970.29	970.51	970.73	970.96	971.18	971.40	971.62	971.85	972.07	38.70
38.80	972.07	972.29	972.51	972.74	972.96	973.18	973.40	973.63	973.85	974.07	974.29	38.80
38.90	974.29	974.51	974.74	974.96	975.18	975.40	975.63	975.85	976.07	976.29	976.52	38.90
39.00	976.52	976.74	976.96	977.18	977.41	977.63	977.85	978.07	978.30	978.52	978.74	39.00
39.10	978.74	978.96	979.19	979.41	979.63	979.85	980.08	980.30	980.52	980.74	980.97	39.10
39.20	980.97	981.19	981.41	981.63	981.86	982.08	982.30	982.52	982.75	982.97	983.19	39.20
39.30	983.19	983.41	983.63	983.86	984.08	984.30	984.52	984.75	984.97	985.19	985.41	39.30
39.40	985.41	985.64	985.86	986.08	986.30	986.53	986.75	986.97	987.19	987.42	987.64	39.40
39.50	987.64	987.86	988.08	988.31	988.53	988.75	988.97	989.20	989.42	989.64	989.86	39.50
39.60	989.86	990.09	990.31	990.53	990.75	990.98	991.20	991.42	991.64	991.87	992.09	39.60
39.70	992.09	992.31	992.53	992.75	992.98	993.20	993.42	993.64	993.87	994.09	994.31	39.70
39.80	994.31	994.53	994.76	994.98	995.20	995.42	995.65	995.87	996.09	996.31	996.54	39.80
39.90	996.54	996.76	996.98	997.20	997.43	997.65	997.87	998.09	998.32	998.54	998.76	39.90
40.00	998.76	998.98	999.21	999.43	999.65	999.87	1000.10	1000.32	1000.54	1000.76	1000.99	40.00
40.10	1000.99	1001.21	1001.43	1001.65	1001.88	1002.10	1002.32	1002.54	1002.77	1002.99	1003.21	40.10
40.20	1003.21	1003.43	1003.65	1003.88	1004.10	1004.32	1004.54	1004.77	1004.99	1005.21	1005.43	40.20
40.30	1005.43	1005.66	1005.88	1006.10	1006.32	1006.55	1006.77	1006.99	1007.21	1007.44	1007.66	40.30
40.40	1007.66	1007.88	1008.10	1008.33	1008.55	1008.77	1008.99	1009.22	1009.44	1009.66	1009.88	40.40
40.50	1009.88	1010.11	1010.33	1010.55	1010.77	1011.00	1011.22	1011.44	1011.66	1011.89	1012.11	40.50
40.60	1012.11	1012.33	1012.55	1012.78	1013.00	1013.22	1013.44	1013.67	1013.89	1014.11	1014.33	40.60
40.70	1014.33	1014.56	1014.78	1015.00	1015.22	1015.45	1015.67	1015.89	1016.11	1016.34	1016.56	40.70
40.80	1016.56	1016.78	1017.00	1017.23	1017.45	1017.67	1017.89	1018.12	1018.34	1018.56	1018.78	40.80
40.90	1018.78	1019.01	1019.23	1019.45	1019.67	1019.90	1020.12	1020.34	1020.56	1020.79	1021.01	40.90
41.00	1021.01	1021.23	1021.45	1021.68	1021.90	1022.12	1022.34	1022.57	1022.79	1023.01	1023.23	41.00
41.10	1023.23	1023.46	1023.68	1023.90	1024.12	1024.35	1024.57	1024.79	1025.01	1025.24	1025.46	41.10
41.20	1025.46	1025.68	1025.90	1026.13	1026.35	1026.57	1026.79	1027.02	1027.24	1027.46	1027.68	41.20
41.30	1027.68	1027.91	1028.13	1028.35	1028.57	1028.80	1029.02	1029.24	1029.46	1029.69	1029.91	41.30
41.40	1029.91	1030.13	1030.35	1030.58	1030.80	1031.02	1031.24	1031.47	1031.69	1031.91	1032.13	41.40
41.50	1032.13	1032.36	1032.58	1032.80	1033.02	1033.25	1033.47	1033.69	1033.92	1034.14	1034.36	41.50
41.60	1034.36	1034.58	1034.81	1035.03	1035.25	1035.47	1035.70	1035.92	1036.14	1036.36	1036.59	41.60
41.70	1036.59	1036.81	1037.03	1037.25	1037.48	1037.70	1037.92	1038.14	1038.37	1038.59	1038.81	41.70
41.80	1038.81	1039.03	1039.26	1039.48	1039.70	1039.92	1040.15	1040.37	1040.59	1040.81	1041.04	41.80
41.90	1041.04	1041.26	1041.48	1041.71	1041.93	1042.15	1042.37	1042.60	1042.82	1043.04	1043.26	41.90
42.00	1043.26	1043.49	1043.71	1043.93	1044.15	1044.38	1044.60	1044.82	1045.04	1045.27	1045.49	42.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. *Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
42.00	1043.26	1043.49	1043.71	1043.93	1044.15	1044.38	1044.60	1044.82	1045.04	1045.27	1045.49	42.00
42.10	1045.49	1045.71	1045.93	1046.16	1046.38	1046.60	1046.83	1047.05	1047.27	1047.49	1047.72	42.10
42.20	1047.72	1047.94	1048.16	1048.38	1048.61	1048.83	1049.05	1049.27	1049.50	1049.72	1049.94	42.20
42.30	1049.94	1050.16	1050.39	1050.61	1050.83	1051.06	1051.28	1051.50	1051.72	1051.95	1052.17	42.30
42.40	1052.17	1052.39	1052.61	1052.84	1053.06	1053.28	1053.50	1053.73	1053.95	1054.17	1054.39	42.40
42.50	1054.39	1054.62	1054.84	1055.06	1055.29	1055.51	1055.73	1055.95	1056.18	1056.40	1056.62	42.50
42.60	1056.62	1056.84	1057.07	1057.29	1057.51	1057.74	1057.96	1058.18	1058.40	1058.63	1058.85	42.60
42.70	1058.85	1059.07	1059.29	1059.52	1059.74	1059.96	1060.18	1060.41	1060.63	1060.85	1061.08	42.70
42.80	1061.08	1061.30	1061.52	1061.74	1061.97	1062.19	1062.41	1062.63	1062.86	1063.08	1063.30	42.80
42.90	1063.30	1063.53	1063.75	1063.97	1064.19	1064.42	1064.64	1064.86	1065.08	1065.31	1065.53	42.90
43.00	1065.53	1065.75	1065.98	1066.20	1066.42	1066.64	1066.87	1067.09	1067.31	1067.53	1067.76	43.00
43.10	1067.76	1067.98	1068.20	1068.43	1068.65	1068.87	1069.09	1069.32	1069.54	1069.76	1069.98	43.10
43.20	1069.98	1070.21	1070.43	1070.65	1070.88	1071.10	1071.32	1071.54	1071.77	1071.99	1072.21	43.20
43.30	1072.21	1072.44	1072.66	1072.88	1073.10	1073.33	1073.55	1073.77	1073.99	1074.22	1074.44	43.30
43.40	1074.44	1074.66	1074.89	1075.11	1075.33	1075.55	1075.78	1076.00	1076.22	1076.45	1076.67	43.40
43.50	1076.67	1076.89	1077.11	1077.34	1077.56	1077.78	1078.01	1078.23	1078.45	1078.67	1078.90	43.50
43.60	1078.90	1079.12	1079.34	1079.56	1079.79	1080.01	1080.23	1080.46	1080.68	1080.90	1081.12	43.60
43.70	1081.12	1081.35	1081.57	1081.79	1082.02	1082.24	1082.46	1082.68	1082.91	1083.13	1083.35	43.70
43.80	1083.35	1083.58	1083.80	1084.02	1084.24	1084.47	1084.69	1084.91	1085.14	1085.36	1085.58	43.80
43.90	1085.58	1085.80	1086.03	1086.25	1086.47	1086.70	1086.92	1087.14	1087.37	1087.59	1087.81	43.90
44.00	1087.81	1088.03	1088.26	1088.48	1088.70	1088.93	1089.15	1089.37	1089.59	1089.82	1090.04	44.00
44.10	1090.04	1090.26	1090.49	1090.71	1090.93	1091.15	1091.38	1091.60	1091.82	1092.05	1092.27	44.10
44.20	1092.27	1092.49	1092.72	1092.94	1093.16	1093.38	1093.61	1093.83	1094.05	1094.28	1094.50	44.20
44.30	1094.50	1094.72	1094.94	1095.17	1095.39	1095.61	1095.84	1096.06	1096.28	1096.51	1096.73	44.30
44.40	1096.73	1096.95	1097.17	1097.40	1097.62	1097.84	1098.07	1098.29	1098.51	1098.74	1098.96	44.40
44.50	1098.96	1099.18	1099.40	1099.63	1099.85	1100.07	1100.30	1100.52	1100.74	1100.97	1101.19	44.50
44.60	1101.19	1101.41	1101.63	1101.86	1102.08	1102.30	1102.53	1102.75	1102.97	1103.20	1103.42	44.60
44.70	1103.42	1103.64	1103.86	1104.09	1104.31	1104.53	1104.76	1104.98	1105.20	1105.43	1105.65	44.70
44.80	1105.65	1105.87	1106.10	1106.32	1106.54	1106.76	1106.99	1107.21	1107.43	1107.66	1107.88	44.80
44.90	1107.88	1108.10	1108.33	1108.55	1108.77	1108.99	1109.22	1109.44	1109.66	1109.89	1110.11	44.90
45.00	1110.11	1110.33	1110.56	1110.78	1111.00	1111.23	1111.45	1111.67	1111.90	1112.12	1112.34	45.00
45.10	1112.34	1112.56	1112.79	1113.01	1113.23	1113.46	1113.68	1113.90	1114.13	1114.35	1114.57	45.10
45.20	1114.57	1114.80	1115.02	1115.24	1115.47	1115.69	1115.91	1116.13	1116.36	1116.58	1116.80	45.20
45.30	1116.80	1117.03	1117.25	1117.47	1117.70	1117.92	1118.14	1118.37	1118.59	1118.81	1119.04	45.30
45.40	1119.04	1119.26	1119.48	1119.71	1119.93	1120.15	1120.38	1120.60	1120.82	1121.04	1121.27	45.40
45.50	1121.27	1121.49	1121.71	1121.94	1122.16	1122.38	1122.61	1122.83	1123.05	1123.28	1123.50	45.50
45.60	1123.50	1123.72	1123.95	1124.17	1124.39	1124.62	1124.84	1125.06	1125.29	1125.51	1125.73	45.60
45.70	1125.73	1125.96	1126.18	1126.40	1126.63	1126.85	1127.07	1127.30	1127.52	1127.74	1127.97	45.70
45.80	1127.97	1128.19	1128.41	1128.64	1128.86	1129.08	1129.31	1129.53	1129.75	1129.97	1130.20	45.80
45.90	1130.20	1130.42	1130.64	1130.87	1131.09	1131.31	1131.54	1131.76	1131.98	1132.21	1132.43	45.90
46.00	1132.43	1132.65	1132.88	1133.10	1133.32	1133.55	1133.77	1133.99	1134.22	1134.44	1134.66	46.00
46.10	1134.66	1134.89	1135.11	1135.33	1135.56	1135.78	1136.00	1136.23	1136.45	1136.68	1136.90	46.10
46.20	1136.90	1137.12	1137.35	1137.57	1137.79	1138.02	1138.24	1138.46	1138.69	1138.91	1139.13	46.20
46.30	1139.13	1139.36	1139.58	1139.80	1140.03	1140.25	1140.47	1140.70	1140.92	1141.14	1141.37	46.30
46.40	1141.37	1141.59	1141.81	1142.04	1142.26	1142.48	1142.71	1142.93	1143.15	1143.38	1143.60	46.40
46.50	1143.60	1143.82	1144.05	1144.27	1144.49	1144.72	1144.94	1145.17	1145.39	1145.61	1145.84	46.50
46.60	1145.84	1146.06	1146.28	1146.51	1146.73	1146.95	1147.18	1147.40	1147.62	1147.85	1148.07	46.60
46.70	1148.07	1148.29	1148.52	1148.74	1148.96	1149.19	1149.41	1149.64	1149.86	1150.08	1150.31	46.70
46.80	1150.31	1150.53	1150.75	1150.98	1151.20	1151.42	1151.65	1151.87	1152.09	1152.32	1152.54	46.80
46.90	1152.54	1152.76	1152.99	1153.21	1153.44	1153.66	1153.88	1154.11	1154.33	1154.55	1154.78	46.90
47.00	1154.78	1155.00	1155.22	1155.45	1155.67	1155.89	1156.12	1156.34	1156.57	1156.79	1157.01	47.00
47.10	1157.01	1157.24	1157.46	1157.68	1157.91	1158.13	1158.35	1158.58	1158.80	1159.03	1159.25	47.10
47.20	1159.25	1159.47	1159.70	1159.92	1160.14	1160.37	1160.59	1160.81	1161.04	1161.26	1161.49	47.20
47.30	1161.49	1161.71	1161.93	1162.16	1162.38	1162.60	1162.83	1163.05	1163.28	1163.50	1163.72	47.30
47.40	1163.72	1163.95	1164.17	1164.39	1164.62	1164.84	1165.06	1165.29	1165.51	1165.74	1165.96	47.40
47.50	1165.96	1166.18	1166.41	1166.63	1166.85	1167.08	1167.30	1167.53	1167.75	1167.97	1168.20	47.50
47.60	1168.20	1168.42	1168.64	1168.87	1169.09	1169.32	1169.54	1169.76	1169.99	1170.21	1170.43	47.60
47.70	1170.43	1170.66	1170.88	1171.11	1171.33	1171.55	1171.78	1172.00	1172.23	1172.45	1172.67	47.70
47.80	1172.67	1172.90	1173.12	1173.34	1173.57	1173.79	1174.02	1174.24	1174.46	1174.69	1174.91	47.80
47.90	1174.91	1175.14	1175.36	1175.58	1175.81	1176.03	1176.25	1176.48	1176.70	1176.93	1177.15	47.90
48.00	1177.15	1177.37	1177.60	1177.82	1178.05	1178.27	1178.49	1178.72	1178.94	1179.16	1179.39	48.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. Type E thermocouples—temperature ($^{\circ}\text{F}$) as a function of thermoelectric voltage, reference junctions at 32°F —Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
48.00	1177.15	1177.37	1177.60	1177.82	1178.05	1178.27	1178.49	1178.72	1178.94	1179.16	1179.39	48.00
48.10	1179.39	1179.61	1179.84	1180.06	1180.28	1180.51	1180.73	1180.96	1181.18	1181.40	1181.63	48.10
48.20	1181.63	1181.85	1182.08	1182.30	1182.52	1182.75	1182.97	1183.20	1183.42	1183.64	1183.87	48.20
48.30	1183.87	1184.09	1184.32	1184.54	1184.76	1184.99	1185.21	1185.44	1185.66	1185.88	1186.11	48.30
48.40	1186.11	1186.33	1186.56	1186.78	1187.00	1187.23	1187.45	1187.68	1187.90	1188.12	1188.35	48.40
48.50	1188.35	1188.57	1188.80	1189.02	1189.24	1189.47	1189.69	1189.92	1190.14	1190.36	1190.59	48.50
48.60	1190.59	1190.81	1191.04	1191.26	1191.48	1191.71	1191.93	1192.16	1192.38	1192.60	1192.83	48.60
48.70	1192.83	1193.05	1193.28	1193.50	1193.72	1193.95	1194.17	1194.40	1194.62	1194.85	1195.07	48.70
48.80	1195.07	1195.29	1195.52	1195.74	1195.97	1196.19	1196.41	1196.64	1196.86	1197.09	1197.31	48.80
48.90	1197.31	1197.54	1197.76	1197.98	1198.21	1198.43	1198.66	1198.88	1199.10	1199.33	1199.55	48.90
49.00	1199.55	1199.78	1200.00	1200.23	1200.45	1200.67	1200.90	1201.12	1201.35	1201.57	1201.79	49.00
49.10	1201.79	1202.02	1202.24	1202.47	1202.69	1202.92	1203.14	1203.36	1203.59	1203.81	1204.04	49.10
49.20	1204.04	1204.26	1204.49	1204.71	1204.93	1205.16	1205.38	1205.61	1205.83	1206.06	1206.28	49.20
49.30	1206.28	1206.50	1206.73	1206.95	1207.18	1207.40	1207.63	1207.85	1208.07	1208.30	1208.52	49.30
49.40	1208.52	1208.75	1208.97	1209.20	1209.42	1209.64	1209.87	1210.09	1210.32	1210.54	1210.77	49.40
49.50	1210.77	1210.99	1211.21	1211.44	1211.66	1211.89	1212.11	1212.34	1212.56	1212.79	1213.01	49.50
49.60	1213.01	1213.23	1213.46	1213.68	1213.91	1214.13	1214.36	1214.58	1214.81	1215.03	1215.25	49.60
49.70	1215.25	1215.48	1215.70	1215.93	1216.15	1216.38	1216.60	1216.82	1217.05	1217.27	1217.50	49.70
49.80	1217.50	1217.72	1217.95	1218.17	1218.40	1218.62	1218.85	1219.07	1219.29	1219.52	1219.74	49.80
49.90	1219.74	1219.97	1220.19	1220.42	1220.64	1220.87	1221.09	1221.31	1221.54	1221.76	1221.99	49.90
50.00	1221.99	1222.21	1222.44	1222.66	1222.89	1223.11	1223.34	1223.56	1223.78	1224.01	1224.23	50.00
50.10	1224.23	1224.46	1224.68	1224.91	1225.13	1225.36	1225.58	1225.81	1226.03	1226.25	1226.48	50.10
50.20	1226.48	1226.70	1226.93	1227.15	1227.38	1227.60	1227.83	1228.05	1228.28	1228.50	1228.73	50.20
50.30	1228.73	1228.95	1229.17	1229.40	1229.62	1229.85	1230.07	1230.30	1230.52	1230.75	1230.97	50.30
50.40	1230.97	1231.20	1231.42	1231.65	1231.87	1232.10	1232.32	1232.54	1232.77	1232.99	1233.22	50.40
50.50	1233.22	1233.44	1233.67	1233.89	1234.12	1234.34	1234.57	1234.79	1235.02	1235.24	1235.47	50.50
50.60	1235.47	1235.69	1235.92	1236.14	1236.36	1236.59	1236.81	1237.04	1237.26	1237.49	1237.71	50.60
50.70	1237.71	1237.94	1238.16	1238.39	1238.61	1238.84	1239.06	1239.29	1239.51	1239.74	1239.96	50.70
50.80	1239.96	1240.19	1240.41	1240.64	1240.86	1241.09	1241.31	1241.53	1241.76	1241.98	1242.21	50.80
50.90	1242.21	1242.43	1242.66	1242.88	1243.11	1243.33	1243.56	1243.78	1244.01	1244.23	1244.46	50.90
51.00	1244.46	1244.68	1244.91	1245.13	1245.36	1245.58	1245.81	1246.03	1246.26	1246.48	1246.71	51.00
51.10	1246.71	1246.93	1247.16	1247.38	1247.61	1247.83	1248.06	1248.28	1248.51	1248.73	1248.96	51.10
51.20	1248.96	1249.18	1249.41	1249.63	1249.86	1250.08	1250.31	1250.53	1250.76	1250.98	1251.21	51.20
51.30	1251.21	1251.43	1251.66	1251.88	1252.11	1252.33	1252.56	1252.78	1253.01	1253.23	1253.46	51.30
51.40	1253.46	1253.68	1253.91	1254.13	1254.36	1254.58	1254.81	1255.03	1255.26	1255.48	1255.71	51.40
51.50	1255.71	1255.93	1256.16	1256.38	1256.61	1256.83	1257.06	1257.28	1257.51	1257.73	1257.96	51.50
51.60	1257.96	1258.18	1258.41	1258.63	1258.86	1259.08	1259.31	1259.53	1259.76	1259.98	1260.21	51.60
51.70	1260.21	1260.43	1260.66	1260.88	1261.11	1261.33	1261.56	1261.78	1262.01	1262.24	1262.46	51.70
51.80	1262.46	1262.69	1262.91	1263.14	1263.36	1263.59	1263.81	1264.04	1264.26	1264.49	1264.71	51.80
51.90	1264.71	1264.94	1265.16	1265.39	1265.61	1265.84	1266.06	1266.29	1266.51	1266.74	1266.96	51.90
52.00	1266.96	1267.19	1267.42	1267.64	1267.87	1268.09	1268.32	1268.54	1268.77	1268.99	1269.22	52.00
52.10	1269.22	1269.44	1269.67	1269.89	1270.12	1270.34	1270.57	1270.79	1271.02	1271.25	1271.47	52.10
52.20	1271.47	1271.70	1271.92	1272.15	1272.37	1272.60	1272.82	1273.05	1273.27	1273.50	1273.72	52.20
52.30	1273.72	1273.95	1274.18	1274.40	1274.63	1274.85	1275.08	1275.30	1275.53	1275.75	1275.98	52.30
52.40	1275.98	1276.20	1276.43	1276.65	1276.88	1277.11	1277.33	1277.56	1277.78	1278.01	1278.23	52.40
52.50	1278.23	1278.46	1278.68	1278.91	1279.13	1279.36	1279.59	1279.81	1280.04	1280.26	1280.49	52.50
52.60	1280.49	1280.71	1280.94	1281.16	1281.39	1281.62	1281.84	1282.07	1282.29	1282.52	1282.74	52.60
52.70	1282.74	1282.97	1283.19	1283.42	1283.64	1283.87	1284.10	1284.32	1284.55	1284.77	1285.00	52.70
52.80	1285.00	1285.22	1285.45	1285.67	1285.90	1286.13	1286.35	1286.58	1286.80	1287.03	1287.25	52.80
52.90	1287.25	1287.48	1287.71	1287.93	1288.16	1288.38	1288.61	1288.83	1289.06	1289.28	1289.51	52.90
53.00	1289.51	1289.74	1289.96	1290.19	1290.41	1290.64	1290.86	1291.09	1291.32	1291.54	1291.77	53.00
53.10	1291.77	1291.99	1292.22	1292.44	1292.67	1292.90	1293.12	1293.35	1293.57	1293.80	1294.02	53.10
53.20	1294.02	1294.25	1294.48	1294.70	1294.93	1295.15	1295.38	1295.60	1295.83	1296.06	1296.28	53.20
53.30	1296.28	1296.51	1296.73	1296.96	1297.19	1297.41	1297.64	1297.86	1298.09	1298.31	1298.54	53.30
53.40	1298.54	1298.77	1298.99	1299.22	1299.44	1299.67	1299.90	1300.12	1300.35	1300.57	1300.80	53.40
53.50	1300.80	1301.02	1301.25	1301.48	1301.70	1301.93	1302.15	1302.38	1302.61	1302.83	1303.06	53.50
53.60	1303.06	1303.28	1303.51	1303.74	1303.96	1304.19	1304.41	1304.64	1304.86	1305.09	1305.32	53.60
53.70	1305.32	1305.54	1305.77	1305.99	1306.22	1306.45	1306.67	1306.90	1307.12	1307.35	1307.58	53.70
53.80	1307.58	1307.80	1308.03	1308.25	1308.48	1308.71	1308.93	1309.16	1309.38	1309.61	1309.84	53.80
53.90	1309.84	1310.06	1310.29	1310.51	1310.74	1310.97	1311.19	1311.42	1311.64	1311.87	1312.10	53.90
54.00	1312.10	1312.32	1312.55	1312.78	1313.00	1313.23	1313.45	1313.68	1313.91	1314.13	1314.36	54.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. Type E thermocouples—temperature ($^{\circ}\text{F}$) as a function of thermoelectric voltage, reference junctions at 32°F —Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
54.00	1312.10	1312.32	1312.55	1312.78	1313.00	1313.23	1313.45	1313.68	1313.91	1314.13	1314.36	54.00
54.10	1314.36	1314.58	1314.81	1315.04	1315.26	1315.49	1315.71	1315.94	1316.17	1316.39	1316.62	54.10
54.20	1316.62	1316.85	1317.07	1317.30	1317.52	1317.75	1317.98	1318.20	1318.43	1318.65	1318.88	54.20
54.30	1318.88	1319.11	1319.33	1319.56	1319.79	1320.01	1320.24	1320.46	1320.69	1320.92	1321.14	54.30
54.40	1321.14	1321.37	1321.60	1321.82	1322.05	1322.27	1322.50	1322.73	1322.95	1323.18	1323.41	54.40
54.50	1323.41	1323.63	1323.86	1324.08	1324.31	1324.54	1324.76	1324.99	1325.22	1325.44	1325.67	54.50
54.60	1325.67	1325.90	1326.12	1326.35	1326.57	1326.80	1327.03	1327.25	1327.48	1327.71	1327.93	54.60
54.70	1327.93	1328.16	1328.39	1328.61	1328.84	1329.06	1329.29	1329.52	1329.74	1329.97	1330.20	54.70
54.80	1330.20	1330.42	1330.65	1330.88	1331.10	1331.33	1331.56	1331.78	1332.01	1332.23	1332.46	54.80
54.90	1332.46	1332.69	1332.91	1333.14	1333.37	1333.59	1333.82	1334.05	1334.27	1334.50	1334.73	54.90
55.00	1334.73	1334.95	1335.18	1335.41	1335.63	1335.86	1336.08	1336.31	1336.54	1336.76	1336.99	55.00
55.10	1336.99	1337.22	1337.44	1337.67	1337.90	1338.12	1338.35	1338.58	1338.80	1339.03	1339.26	55.10
55.20	1339.26	1339.48	1339.71	1339.94	1340.16	1340.39	1340.62	1340.84	1341.07	1341.30	1341.52	55.20
55.30	1341.52	1341.75	1341.98	1342.20	1342.43	1342.66	1342.88	1343.11	1343.34	1343.56	1343.79	55.30
55.40	1343.79	1344.02	1344.24	1344.47	1344.70	1344.92	1345.15	1345.38	1345.60	1345.83	1346.06	55.40
55.50	1346.06	1346.28	1346.51	1346.74	1346.96	1347.19	1347.42	1347.64	1347.87	1348.10	1348.32	55.50
55.60	1348.32	1348.55	1348.78	1349.00	1349.23	1349.46	1349.68	1349.91	1350.14	1350.37	1350.59	55.60
55.70	1350.59	1350.82	1351.05	1351.27	1351.50	1351.73	1351.95	1352.18	1352.41	1352.63	1352.86	55.70
55.80	1352.86	1353.09	1353.31	1353.54	1353.77	1353.99	1354.22	1354.45	1354.68	1354.90	1355.13	55.80
55.90	1355.13	1355.36	1355.58	1355.81	1356.04	1356.26	1356.49	1356.72	1356.94	1357.17	1357.40	55.90
56.00	1357.40	1357.63	1357.85	1358.08	1358.31	1358.53	1358.76	1358.99	1359.21	1359.44	1359.67	56.00
56.10	1359.67	1359.90	1360.12	1360.35	1360.58	1360.80	1361.03	1361.26	1361.48	1361.71	1361.94	56.10
56.20	1361.94	1362.17	1362.39	1362.62	1362.85	1363.07	1363.30	1363.53	1363.76	1363.98	1364.21	56.20
56.30	1364.21	1364.44	1364.66	1364.89	1365.12	1365.35	1365.57	1365.80	1366.03	1366.25	1366.48	56.30
56.40	1366.48	1366.71	1366.94	1367.16	1367.39	1367.62	1367.84	1368.07	1368.30	1368.53	1368.75	56.40
56.50	1368.75	1368.98	1369.21	1369.43	1369.66	1369.89	1370.12	1370.34	1370.57	1370.80	1371.02	56.50
56.60	1371.02	1371.25	1371.48	1371.71	1371.93	1372.16	1372.39	1372.62	1372.84	1373.07	1373.30	56.60
56.70	1373.30	1373.52	1373.75	1373.98	1374.21	1374.43	1374.66	1374.89	1375.12	1375.34	1375.57	56.70
56.80	1375.57	1375.80	1376.02	1376.25	1376.48	1376.71	1376.93	1377.16	1377.39	1377.62	1377.84	56.80
56.90	1377.84	1378.07	1378.30	1378.53	1378.75	1378.98	1379.21	1379.44	1379.66	1379.89	1380.12	56.90
57.00	1380.12	1380.35	1380.57	1380.80	1381.03	1381.25	1381.48	1381.71	1381.94	1382.16	1382.39	57.00
57.10	1382.39	1382.62	1382.85	1383.07	1383.30	1383.53	1383.76	1383.98	1384.21	1384.44	1384.67	57.10
57.20	1384.67	1384.89	1385.12	1385.35	1385.58	1385.80	1386.03	1386.26	1386.49	1386.72	1386.94	57.20
57.30	1386.94	1387.17	1387.40	1387.63	1387.85	1388.08	1388.31	1388.54	1388.76	1388.99	1389.22	57.30
57.40	1389.22	1389.45	1389.67	1389.90	1390.13	1390.36	1390.58	1390.81	1391.04	1391.27	1391.49	57.40
57.50	1391.49	1391.72	1391.95	1392.18	1392.41	1392.63	1392.86	1393.09	1393.32	1393.54	1393.77	57.50
57.60	1393.77	1394.00	1394.23	1394.45	1394.68	1394.91	1395.14	1395.37	1395.59	1395.82	1396.05	57.60
57.70	1396.05	1396.28	1396.50	1396.73	1396.96	1397.19	1397.42	1397.64	1397.87	1398.10	1398.33	57.70
57.80	1398.33	1398.55	1398.78	1399.01	1399.24	1399.47	1399.69	1399.92	1400.15	1400.38	1400.61	57.80
57.90	1400.61	1400.83	1401.06	1401.29	1401.52	1401.74	1401.97	1402.20	1402.43	1402.66	1402.88	57.90
58.00	1402.88	1403.11	1403.34	1403.57	1403.80	1404.02	1404.25	1404.48	1404.71	1404.94	1405.16	58.00
58.10	1405.16	1405.39	1405.62	1405.85	1406.08	1406.30	1406.53	1406.76	1406.99	1407.22	1407.44	58.10
58.20	1407.44	1407.67	1407.90	1408.13	1408.36	1408.58	1408.81	1409.04	1409.27	1409.50	1409.72	58.20
58.30	1409.72	1409.95	1410.18	1410.41	1410.64	1410.86	1411.09	1411.32	1411.55	1411.78	1412.00	58.30
58.40	1412.00	1412.23	1412.46	1412.69	1412.92	1413.15	1413.37	1413.60	1413.83	1414.06	1414.29	58.40
58.50	1414.29	1414.51	1414.74	1414.97	1415.20	1415.43	1415.66	1415.88	1416.11	1416.34	1416.57	58.50
58.60	1416.57	1416.80	1417.02	1417.25	1417.48	1417.71	1417.94	1418.17	1418.39	1418.62	1418.85	58.60
58.70	1418.85	1419.08	1419.31	1419.54	1419.76	1419.99	1420.22	1420.45	1420.68	1420.90	1421.13	58.70
58.80	1421.13	1421.36	1421.59	1421.82	1422.05	1422.27	1422.50	1422.73	1422.96	1423.19	1423.42	58.80
58.90	1423.42	1423.64	1423.87	1424.10	1424.33	1424.56	1424.79	1425.02	1425.24	1425.47	1425.70	58.90
59.00	1425.70	1425.93	1426.16	1426.39	1426.61	1426.84	1427.07	1427.30	1427.53	1427.76	1427.98	59.00
59.10	1427.98	1428.21	1428.44	1428.67	1428.90	1429.13	1429.36	1429.58	1429.81	1430.04	1430.27	59.10
59.20	1430.27	1430.50	1430.73	1430.96	1431.18	1431.41	1431.64	1431.87	1432.10	1432.33	1432.56	59.20
59.30	1432.56	1432.78	1433.01	1433.24	1433.47	1433.70	1433.93	1434.16	1434.38	1434.61	1434.84	59.30
59.40	1434.84	1435.07	1435.30	1435.53	1435.76	1435.98	1436.21	1436.44	1436.67	1436.90	1437.13	59.40
59.50	1437.13	1437.36	1437.58	1437.81	1438.04	1438.27	1438.50	1438.73	1438.96	1439.19	1439.41	59.50
59.60	1439.41	1439.64	1439.87	1440.10	1440.33	1440.56	1440.79	1441.02	1441.24	1441.47	1441.70	59.60
59.70	1441.70	1441.93	1442.16	1442.39	1442.62	1442.85	1443.07	1443.30	1443.53	1443.76	1443.99	59.70
59.80	1443.99	1444.22	1444.45	1444.68	1444.91	1445.13	1445.36	1445.59	1445.82	1446.05	1446.28	59.80
59.90	1446.28	1446.51	1446.74	1446.97	1447.19	1447.42	1447.65	1447.88	1448.11	1448.34	1448.57	59.90
60.00	1448.57	1448.80	1449.03	1449.25	1449.48	1449.71	1449.94	1450.17	1450.40	1450.63	1450.86	60.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. *Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
60.00	1448.57	1448.80	1449.03	1449.25	1449.48	1449.71	1449.94	1450.17	1450.40	1450.63	1450.86	60.00
60.10	1450.86	1451.09	1451.32	1451.54	1451.77	1452.00	1452.23	1452.46	1452.69	1452.92	1453.15	60.10
60.20	1453.15	1453.38	1453.61	1453.83	1454.06	1454.29	1454.52	1454.75	1454.98	1455.21	1455.44	60.20
60.30	1455.44	1455.67	1455.90	1456.13	1456.35	1456.58	1456.81	1457.04	1457.27	1457.50	1457.73	60.30
60.40	1457.73	1457.96	1458.19	1458.42	1458.65	1458.88	1459.10	1459.33	1459.56	1459.79	1460.02	60.40
60.50	1460.02	1460.25	1460.48	1460.71	1460.94	1461.17	1461.40	1461.63	1461.86	1462.08	1462.31	60.50
60.60	1462.31	1462.54	1462.77	1463.00	1463.23	1463.46	1463.69	1463.92	1464.15	1464.38	1464.61	60.60
60.70	1464.61	1464.84	1465.07	1465.29	1465.52	1465.75	1465.98	1466.21	1466.44	1466.67	1466.90	60.70
60.80	1466.90	1467.13	1467.36	1467.59	1467.82	1468.05	1468.28	1468.51	1468.74	1468.96	1469.19	60.80
60.90	1469.19	1469.42	1469.65	1469.88	1470.11	1470.34	1470.57	1470.80	1471.03	1471.26	1471.49	60.90
61.00	1471.49	1471.72	1471.95	1472.18	1472.41	1472.64	1472.87	1473.10	1473.32	1473.55	1473.78	61.00
61.10	1473.78	1474.01	1474.24	1474.47	1474.70	1474.93	1475.16	1475.39	1475.62	1475.85	1476.08	61.10
61.20	1476.08	1476.31	1476.54	1476.77	1477.00	1477.23	1477.46	1477.69	1477.92	1478.15	1478.38	61.20
61.30	1478.38	1478.61	1478.84	1479.06	1479.29	1479.52	1479.75	1479.98	1480.21	1480.44	1480.67	61.30
61.40	1480.67	1480.90	1481.13	1481.36	1481.59	1481.82	1482.05	1482.28	1482.51	1482.74	1482.97	61.40
61.50	1482.97	1483.20	1483.43	1483.66	1483.89	1484.12	1484.35	1484.58	1484.81	1485.04	1485.27	61.50
61.60	1485.27	1485.50	1485.73	1485.96	1486.19	1486.42	1486.65	1486.88	1487.11	1487.34	1487.57	61.60
61.70	1487.57	1487.80	1488.03	1488.26	1488.49	1488.72	1488.95	1489.18	1489.41	1489.64	1489.87	61.70
61.80	1489.87	1490.10	1490.33	1490.56	1490.79	1491.02	1491.25	1491.48	1491.71	1491.94	1492.17	61.80
61.90	1492.17	1492.40	1492.63	1492.86	1493.09	1493.32	1493.55	1493.78	1494.01	1494.24	1494.47	61.90
62.00	1494.47	1494.70	1494.93	1495.16	1495.39	1495.62	1495.85	1496.08	1496.31	1496.54	1496.77	62.00
62.10	1496.77	1497.00	1497.23	1497.46	1497.69	1497.92	1498.15	1498.38	1498.61	1498.84	1499.07	62.10
62.20	1499.07	1499.30	1499.53	1499.76	1499.99	1500.22	1500.45	1500.68	1500.91	1501.14	1501.37	62.20
62.30	1501.37	1501.60	1501.83	1502.06	1502.29	1502.52	1502.75	1502.98	1503.21	1503.44	1503.67	62.30
62.40	1503.67	1503.90	1504.13	1504.36	1504.59	1504.82	1505.05	1505.28	1505.51	1505.75	1505.98	62.40
62.50	1505.98	1506.21	1506.44	1506.67	1506.90	1507.13	1507.36	1507.59	1507.82	1508.05	1508.28	62.50
62.60	1508.28	1508.51	1508.74	1508.97	1509.20	1509.43	1509.66	1509.89	1510.12	1510.35	1510.58	62.60
62.70	1510.58	1510.81	1511.04	1511.28	1511.51	1511.74	1511.97	1512.20	1512.43	1512.66	1512.89	62.70
62.80	1512.89	1513.12	1513.35	1513.58	1513.81	1514.04	1514.27	1514.50	1514.73	1514.96	1515.19	62.80
62.90	1515.19	1515.42	1515.66	1515.89	1516.12	1516.35	1516.58	1516.81	1517.04	1517.27	1517.50	62.90
63.00	1517.50	1517.73	1517.96	1518.19	1518.42	1518.65	1518.88	1519.12	1519.35	1519.58	1519.81	63.00
63.10	1519.81	1520.04	1520.27	1520.50	1520.73	1520.96	1521.19	1521.42	1521.65	1521.88	1522.11	63.10
63.20	1522.11	1522.35	1522.58	1522.81	1523.04	1523.27	1523.50	1523.73	1523.96	1524.19	1524.42	63.20
63.30	1524.42	1524.65	1524.88	1525.12	1525.35	1525.58	1525.81	1526.04	1526.27	1526.50	1526.73	63.30
63.40	1526.73	1526.96	1527.19	1527.42	1527.65	1527.89	1528.12	1528.35	1528.58	1528.81	1529.04	63.40
63.50	1529.04	1529.27	1529.50	1529.73	1529.96	1530.20	1530.43	1530.66	1530.89	1531.12	1531.35	63.50
63.60	1531.35	1531.58	1531.81	1532.04	1532.27	1532.51	1532.74	1532.97	1533.20	1533.43	1533.66	63.60
63.70	1533.66	1533.89	1534.12	1534.35	1534.59	1534.82	1535.05	1535.28	1535.51	1535.74	1535.97	63.70
63.80	1535.97	1536.20	1536.43	1536.67	1536.90	1537.13	1537.36	1537.59	1537.82	1538.05	1538.28	63.80
63.90	1538.28	1538.52	1538.75	1538.98	1539.21	1539.44	1539.67	1539.90	1540.13	1540.36	1540.60	63.90
64.00	1540.60	1540.83	1541.06	1541.29	1541.52	1541.75	1541.98	1542.22	1542.45	1542.68	1542.91	64.00
64.10	1542.91	1543.14	1543.37	1543.60	1543.83	1544.07	1544.30	1544.53	1544.76	1544.99	1545.22	64.10
64.20	1545.22	1545.45	1545.69	1545.92	1546.15	1546.38	1546.61	1546.84	1547.07	1547.31	1547.54	64.20
64.30	1547.54	1547.77	1548.00	1548.23	1548.46	1548.69	1548.93	1549.16	1549.39	1549.62	1549.85	64.30
64.40	1549.85	1550.08	1550.32	1550.55	1550.78	1551.01	1551.24	1551.47	1551.70	1551.94	1552.17	64.40
64.50	1552.17	1552.40	1552.63	1552.86	1553.09	1553.33	1553.56	1553.79	1554.02	1554.25	1554.48	64.50
64.60	1554.48	1554.72	1554.95	1555.18	1555.41	1555.64	1555.87	1556.11	1556.34	1556.57	1556.80	64.60
64.70	1556.80	1557.03	1557.26	1557.50	1557.73	1557.96	1558.19	1558.42	1558.65	1558.89	1559.12	64.70
64.80	1559.12	1559.35	1559.58	1559.81	1560.05	1560.28	1560.51	1560.74	1560.97	1561.20	1561.44	64.80
64.90	1561.44	1561.67	1561.90	1562.13	1562.36	1562.60	1562.83	1563.06	1563.29	1563.52	1563.76	64.90
65.00	1563.76	1563.99	1564.22	1564.45	1564.68	1564.92	1565.15	1565.38	1565.61	1565.84	1566.08	65.00
65.10	1566.08	1566.31	1566.54	1566.77	1567.00	1567.24	1567.47	1567.70	1567.93	1568.16	1568.40	65.10
65.20	1568.40	1568.63	1568.86	1569.09	1569.32	1569.56	1569.79	1570.02	1570.25	1570.48	1570.72	65.20
65.30	1570.72	1570.95	1571.18	1571.41	1571.64	1571.88	1572.11	1572.34	1572.57	1572.81	1573.04	65.30
65.40	1573.04	1573.27	1573.50	1573.73	1573.97	1574.20	1574.43	1574.66	1574.90	1575.13	1575.36	65.40
65.50	1575.36	1575.59	1575.82	1576.06	1576.29	1576.52	1576.75	1576.99	1577.22	1577.45	1577.68	65.50
65.60	1577.68	1577.92	1578.15	1578.38	1578.61	1578.84	1579.08	1579.31	1579.54	1579.77	1580.01	65.60
65.70	1580.01	1580.24	1580.47	1580.70	1580.94	1581.17	1581.40	1581.63	1581.87	1582.10	1582.33	65.70
65.80	1582.33	1582.56	1582.80	1583.03	1583.26	1583.49	1583.73	1583.96	1584.19	1584.42	1584.66	65.80
65.90	1584.66	1584.89	1585.12	1585.35	1585.59	1585.82	1586.05	1586.28	1586.52	1586.75	1586.98	65.90
66.00	1586.98	1587.21	1587.45	1587.68	1587.91	1588.14	1588.38	1588.61	1588.84	1589.08	1589.31	66.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
66.00	1586.98	1587.21	1587.45	1587.68	1587.91	1588.14	1588.38	1588.61	1588.84	1589.08	1589.31	66.00
66.10	1589.31	1589.54	1589.77	1590.01	1590.24	1590.47	1590.70	1590.94	1591.17	1591.40	1591.64	66.10
66.20	1591.64	1591.87	1592.10	1592.33	1592.57	1592.80	1593.03	1593.26	1593.50	1593.73	1593.96	66.20
66.30	1593.96	1594.20	1594.43	1594.66	1594.89	1595.13	1595.36	1595.59	1595.83	1596.06	1596.29	66.30
66.40	1596.29	1596.52	1596.76	1596.99	1597.22	1597.46	1597.69	1597.92	1598.16	1598.39	1598.62	66.40
66.50	1598.62	1598.85	1599.09	1599.32	1599.55	1599.79	1600.02	1600.25	1600.48	1600.72	1600.95	66.50
66.60	1600.95	1601.18	1601.42	1601.65	1601.88	1602.12	1602.35	1602.58	1602.82	1603.05	1603.28	66.60
66.70	1603.28	1603.51	1603.75	1603.98	1604.21	1604.45	1604.68	1604.91	1605.15	1605.38	1605.61	66.70
66.80	1605.61	1605.85	1606.08	1606.31	1606.55	1606.78	1607.01	1607.25	1607.48	1607.71	1607.95	66.80
66.90	1607.95	1608.18	1608.41	1608.64	1608.88	1609.11	1609.34	1609.58	1609.81	1610.04	1610.28	66.90
67.00	1610.28	1610.51	1610.74	1610.98	1611.21	1611.44	1611.68	1611.91	1612.14	1612.38	1612.61	67.00
67.10	1612.61	1612.84	1613.08	1613.31	1613.55	1613.78	1614.01	1614.25	1614.48	1614.71	1614.95	67.10
67.20	1614.95	1615.18	1615.41	1615.65	1615.88	1616.11	1616.35	1616.58	1616.81	1617.05	1617.28	67.20
67.30	1617.28	1617.51	1617.75	1617.98	1618.21	1618.45	1618.68	1618.92	1619.15	1619.38	1619.62	67.30
67.40	1619.62	1619.85	1620.08	1620.32	1620.55	1620.78	1621.02	1621.25	1621.49	1621.72	1621.95	67.40
67.50	1621.95	1622.19	1622.42	1622.65	1622.89	1623.12	1623.36	1623.59	1623.82	1624.06	1624.29	67.50
67.60	1624.29	1624.52	1624.76	1624.99	1625.23	1625.46	1625.69	1625.93	1626.16	1626.39	1626.63	67.60
67.70	1626.63	1626.86	1627.10	1627.33	1627.56	1627.80	1628.03	1628.27	1628.50	1628.73	1628.97	67.70
67.80	1628.97	1629.20	1629.43	1629.67	1629.90	1630.14	1630.37	1630.60	1630.84	1631.07	1631.31	67.80
67.90	1631.31	1631.54	1631.77	1632.01	1632.24	1632.48	1632.71	1632.94	1633.18	1633.41	1633.65	67.90
68.00	1633.65	1633.88	1634.12	1634.35	1634.58	1634.82	1635.05	1635.29	1635.52	1635.75	1635.99	68.00
68.10	1635.99	1636.22	1636.46	1636.69	1636.92	1637.16	1637.39	1637.63	1637.86	1638.10	1638.33	68.10
68.20	1638.33	1638.56	1638.80	1639.03	1639.27	1639.50	1639.74	1639.97	1640.20	1640.44	1640.67	68.20
68.30	1640.67	1640.91	1641.14	1641.38	1641.61	1641.84	1642.08	1642.31	1642.55	1642.78	1643.02	68.30
68.40	1643.02	1643.25	1643.48	1643.72	1643.95	1644.19	1644.42	1644.66	1644.89	1645.13	1645.36	68.40
68.50	1645.36	1645.59	1645.83	1646.06	1646.30	1646.53	1646.77	1647.00	1647.24	1647.47	1647.70	68.50
68.60	1647.70	1647.94	1648.17	1648.41	1648.64	1648.88	1649.11	1649.35	1649.58	1649.82	1650.05	68.60
68.70	1650.05	1650.28	1650.52	1650.75	1650.99	1651.22	1651.46	1651.69	1651.93	1652.16	1652.40	68.70
68.80	1652.40	1652.63	1652.87	1653.10	1653.34	1653.57	1653.80	1654.04	1654.27	1654.51	1654.74	68.80
68.90	1654.74	1654.98	1655.21	1655.45	1655.68	1655.92	1656.15	1656.39	1656.62	1656.86	1657.09	68.90
69.00	1657.09	1657.33	1657.56	1657.80	1658.03	1658.27	1658.50	1658.74	1658.97	1659.21	1659.44	69.00
69.10	1659.44	1659.68	1659.91	1660.15	1660.38	1660.62	1660.85	1661.09	1661.32	1661.56	1661.79	69.10
69.20	1661.79	1662.03	1662.26	1662.50	1662.73	1662.97	1663.20	1663.44	1663.67	1663.91	1664.14	69.20
69.30	1664.14	1664.38	1664.61	1664.85	1665.08	1665.32	1665.55	1665.79	1666.02	1666.26	1666.49	69.30
69.40	1666.49	1666.73	1666.96	1667.20	1667.43	1667.67	1667.90	1668.14	1668.37	1668.61	1668.84	69.40
69.50	1668.84	1669.08	1669.31	1669.55	1669.78	1670.02	1670.26	1670.49	1670.73	1670.96	1671.20	69.50
69.60	1671.20	1671.43	1671.67	1671.90	1672.14	1672.37	1672.61	1672.84	1673.08	1673.31	1673.55	69.60
69.70	1673.55	1673.79	1674.02	1674.26	1674.49	1674.73	1674.96	1675.20	1675.43	1675.67	1675.90	69.70
69.80	1675.90	1676.14	1676.38	1676.61	1676.85	1677.08	1677.32	1677.55	1677.79	1678.02	1678.26	69.80
69.90	1678.26	1678.50	1678.73	1678.97	1679.20	1679.44	1679.67	1679.91	1680.14	1680.38	1680.62	69.90
70.00	1680.62	1680.85	1681.09	1681.32	1681.56	1681.79	1682.03	1682.27	1682.50	1682.74	1682.97	70.00
70.10	1682.97	1683.21	1683.44	1683.68	1683.92	1684.15	1684.39	1684.62	1684.86	1685.09	1685.33	70.10
70.20	1685.33	1685.57	1685.80	1686.04	1686.27	1686.51	1686.74	1686.98	1687.22	1687.45	1687.69	70.20
70.30	1687.69	1687.92	1688.16	1688.40	1688.63	1688.87	1689.10	1689.34	1689.58	1689.81	1690.05	70.30
70.40	1690.05	1690.28	1690.52	1690.76	1690.99	1691.23	1691.46	1691.70	1691.94	1692.17	1692.41	70.40
70.50	1692.41	1692.64	1692.88	1693.12	1693.35	1693.59	1693.82	1694.06	1694.30	1694.53	1694.77	70.50
70.60	1694.77	1695.00	1695.24	1695.48	1695.71	1695.95	1696.19	1696.42	1696.66	1696.89	1697.13	70.60
70.70	1697.13	1697.37	1697.60	1697.84	1698.08	1698.31	1698.55	1698.78	1699.02	1699.26	1699.49	70.70
70.80	1699.49	1699.73	1699.97	1700.20	1700.44	1700.67	1700.91	1701.15	1701.38	1701.62	1701.86	70.80
70.90	1701.86	1702.09	1702.33	1702.57	1702.80	1703.04	1703.27	1703.51	1703.75	1703.98	1704.22	70.90
71.00	1704.22	1704.46	1704.69	1704.93	1705.17	1705.40	1705.64	1705.88	1706.11	1706.35	1706.58	71.00
71.10	1706.58	1706.82	1707.06	1707.29	1707.53	1707.77	1708.00	1708.24	1708.48	1708.71	1708.95	71.10
71.20	1708.95	1709.19	1709.42	1709.66	1709.90	1710.13	1710.37	1710.61	1710.84	1711.08	1711.32	71.20
71.30	1711.32	1711.55	1711.79	1712.03	1712.26	1712.50	1712.74	1712.97	1713.21	1713.45	1713.68	71.30
71.40	1713.68	1713.92	1714.16	1714.39	1714.63	1714.87	1715.11	1715.34	1715.58	1715.82	1716.05	71.40
71.50	1716.05	1716.29	1716.53	1716.76	1717.00	1717.24	1717.47	1717.71	1717.95	1718.18	1718.42	71.50
71.60	1718.42	1718.66	1718.90	1719.13	1719.37	1719.61	1719.84	1720.08	1720.32	1720.55	1720.79	71.60
71.70	1720.79	1721.03	1721.27	1721.50	1721.74	1721.98	1722.21	1722.45	1722.69	1722.93	1723.16	71.70
71.80	1723.16	1723.40	1723.64	1723.87	1724.11	1724.35	1724.58	1724.82	1725.06	1725.30	1725.53	71.80
71.90	1725.53	1725.77	1726.01	1726.25	1726.48	1726.72	1726.96	1727.19	1727.43	1727.67	1727.91	71.90
72.00	1727.91	1728.14	1728.38	1728.62	1728.85	1729.09	1729.33	1729.57	1729.80	1730.04	1730.28	72.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.2. Type E thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
72.00	1727.91	1728.14	1728.38	1728.62	1728.85	1729.09	1729.33	1729.57	1729.80	1730.04	1730.28	72.00
72.10	1730.28	1730.52	1730.75	1730.99	1731.23	1731.47	1731.70	1731.94	1732.18	1732.42	1732.65	72.10
72.20	1732.65	1732.89	1733.13	1733.37	1733.60	1733.84	1734.08	1734.31	1734.55	1734.79	1735.03	72.20
72.30	1735.03	1735.26	1735.50	1735.74	1735.98	1736.22	1736.45	1736.69	1736.93	1737.17	1737.40	72.30
72.40	1737.40	1737.64	1737.88	1738.12	1738.35	1738.59	1738.83	1739.07	1739.30	1739.54	1739.78	72.40
72.50	1739.78	1740.02	1740.25	1740.49	1740.73	1740.97	1741.21	1741.44	1741.68	1741.92	1742.16	72.50
72.60	1742.16	1742.39	1742.63	1742.87	1743.11	1743.35	1743.58	1743.82	1744.06	1744.30	1744.53	72.60
72.70	1744.53	1744.77	1745.01	1745.25	1745.49	1745.72	1745.96	1746.20	1746.44	1746.67	1746.91	72.70
72.80	1746.91	1747.15	1747.39	1747.63	1747.86	1748.10	1748.34	1748.58	1748.82	1749.05	1749.29	72.80
72.90	1749.29	1749.53	1749.77	1750.01	1750.24	1750.48	1750.72	1750.96	1751.20	1751.43	1751.67	72.90
73.00	1751.67	1751.91	1752.15	1752.39	1752.62	1752.86	1753.10	1753.34	1753.58	1753.82	1754.05	73.00
73.10	1754.05	1754.29	1754.53	1754.77	1755.01	1755.24	1755.48	1755.72	1755.96	1756.20	1756.44	73.10
73.20	1756.44	1756.67	1756.91	1757.15	1757.39	1757.63	1757.86	1758.10	1758.34	1758.58	1758.82	73.20
73.30	1758.82	1759.06	1759.29	1759.53	1759.77	1760.01	1760.25	1760.49	1760.72	1760.96	1761.20	73.30
73.40	1761.20	1761.44	1761.68	1761.92	1762.15	1762.39	1762.63	1762.87	1763.11	1763.35	1763.59	73.40
73.50	1763.59	1763.82	1764.06	1764.30	1764.54	1764.78	1765.02	1765.25	1765.49	1765.73	1765.97	73.50
73.60	1765.97	1766.21	1766.45	1766.69	1766.92	1767.16	1767.40	1767.64	1767.88	1768.12	1768.36	73.60
73.70	1768.36	1768.59	1768.83	1769.07	1769.31	1769.55	1769.79	1770.03	1770.27	1770.50	1770.74	73.70
73.80	1770.74	1770.98	1771.22	1771.46	1771.70	1771.94	1772.17	1772.41	1772.65	1772.89	1773.13	73.80
73.90	1773.13	1773.37	1773.61	1773.85	1774.08	1774.32	1774.56	1774.80	1775.04	1775.28	1775.52	73.90
74.00	1775.52	1775.76	1776.00	1776.23	1776.47	1776.71	1776.95	1777.19	1777.43	1777.67	1777.91	74.00
74.10	1777.91	1778.14	1778.38	1778.62	1778.86	1779.10	1779.34	1779.58	1779.82	1780.06	1780.30	74.10
74.20	1780.30	1780.53	1780.77	1781.01	1781.25	1781.49	1781.73	1781.97	1782.21	1782.45	1782.69	74.20
74.30	1782.69	1782.92	1783.16	1783.40	1783.64	1783.88	1784.12	1784.36	1784.60	1784.84	1785.08	74.30
74.40	1785.08	1785.32	1785.55	1785.79	1786.03	1786.27	1786.51	1786.75	1786.99	1787.23	1787.47	74.40
74.50	1787.47	1787.71	1787.95	1788.18	1788.42	1788.66	1788.90	1789.14	1789.38	1789.62	1789.86	74.50
74.60	1789.86	1790.10	1790.34	1790.58	1790.82	1791.06	1791.30	1791.53	1791.77	1792.01	1792.25	74.60
74.70	1792.25	1792.49	1792.73	1792.97	1793.21	1793.45	1793.69	1793.93	1794.17	1794.41	1794.65	74.70
74.80	1794.65	1794.89	1795.12	1795.36	1795.60	1795.84	1796.08	1796.32	1796.56	1796.80	1797.04	74.80
74.90	1797.04	1797.28	1797.52	1797.76	1798.00	1798.24	1798.48	1798.72	1798.96	1799.19	1799.43	74.90
75.00	1799.43	1799.67	1799.91	1800.15	1800.39	1800.63	1800.87	1801.11	1801.35	1801.59	1801.83	75.00
75.10	1801.83	1802.07	1802.31	1802.55	1802.79	1803.03	1803.27	1803.51	1803.75	1803.99	1804.23	75.10
75.20	1804.23	1804.47	1804.71	1804.94	1805.18	1805.42	1805.66	1805.90	1806.14	1806.38	1806.62	75.20
75.30	1806.62	1806.86	1807.10	1807.34	1807.58	1807.82	1808.06	1808.30	1808.54	1808.78	1809.02	75.30
75.40	1809.02	1809.26	1809.50	1809.74	1809.98	1810.22	1810.46	1810.70	1810.94	1811.18	1811.42	75.40
75.50	1811.42	1811.66	1811.90	1812.14	1812.38	1812.62	1812.86	1813.10	1813.34	1813.58	1813.82	75.50
75.60	1813.82	1814.06	1814.30	1814.54	1814.78	1815.01	1815.25	1815.49	1815.73	1815.97	1816.21	75.60
75.70	1816.21	1816.45	1816.69	1816.93	1817.17	1817.41	1817.65	1817.89	1818.13	1818.37	1818.61	75.70
75.80	1818.61	1818.85	1819.09	1819.33	1819.57	1819.81	1820.05	1820.29	1820.53	1820.77	1821.01	75.80
75.90	1821.01	1821.25	1821.49	1821.73	1821.97	1822.21	1822.45	1822.69	1822.93	1823.17	1823.41	75.90
76.00	1823.41	1823.65	1823.89	1824.13	1824.37	1824.61	1824.85	1825.09	1825.33	1825.58	1825.82	76.00
76.10	1825.82	1826.06	1826.30	1826.54	1826.78	1827.02	1827.26	1827.50	1827.74	1827.98	1828.22	76.10
76.20	1828.22	1828.46	1828.70	1828.94	1829.18	1829.42	1829.66	1829.90	1830.14	1830.38	1830.62	76.20
76.30	1830.62	1830.86	1831.10	1831.34	1831.58	1831.82						76.30
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A5.2.3. Type E thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges (°C). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius

Temperature Range (°C)		a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (°C)
		Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation												
-270 to 0	..	..	..	2.8168878	-3	-8.5940057	-6	-1.4930918	-9	-8.7987588	-14	-9 to 6
-200 to 0	..	..	..	1.5726646	-2	-1.2102152	-6	-1.9577799	-10	-1.6696298	-14	-.3 to .3
-200 to 800	..	..	..	1.8432856	-2	-3.2311582	-7	6.9795810	-12	-5.1106852	-17	-8 to 7
-20 to 500	..	..	..	1.6970287	-2	-2.0830603	-7	4.6512717	-12	-4.1805785	-17	-.18 to .12
0 to 400	..	..	..	1.7022525	-2	-2.2097240	-7	5.4809314	-12	-5.7669892	-17	-.05 to .04
0 to 1000	..	..	..	1.6410783	-2	-1.3560189	-7	1.8600342	-12	-8.5537337	-18	-.9 to 1.4
400 to 1000	1.9669452	+1	..	1.4207735	-2	-5.1844510	-8	5.6361365	-13	1.5646343	-18	-.03 to .03
600 to 800	2.5192188	+1	..	1.3909529	-2	-4.7201133	-8	5.5638718	-13	-1.7775228	-18	-.0005 to .0005
850 to 1000	-7.1102114	+2	..	5.6554599	-2	-9.7013068	-7	9.3938146	-12	-3.3333675	-17	-.001 to .001
II. Cubic Equation												
-270 to 0	..	..	..	2.5551958	-2	2.9621132	-6	3.0768135	-10	..	..	-13 to 8
-200 to 0	..	..	..	1.8633205	-2	4.8347537	-7	1.0509221	-10	..	..	-1.1 to .8
-200 to 800	..	..	..	1.8188334	-2	-2.0345919	-7	1.9991341	-12	..	..	-23 to 11
-20 to 500	..	..	..	1.6588304	-2	-1.4544432	-7	1.6926259	-12	..	..	-.8 to .8
0 to 400	..	..	..	1.6762456	-2	-1.6713867	-7	2.2710476	-12	..	..	-.4 to .4
0 to 1000	..	..	..	1.5684151	-2	-7.9238828	-8	5.9738218	-13	..	..	-3 to 4
400 to 1000	2.9347907	+1	..	1.3385134	-2	-2.6669218	-8	2.3388779	-13	..	..	-.09 to .08
600 to 800	3.8917006	+1	..	1.2862075	-2	-1.7338216	-8	1.7943524	-13	..	..	-.001 to .001
850 to 1000	1.1236815	+2	..	9.7592314	-3	2.6085395	-8	-2.1667359	-14	..	..	-.005 to .007
III. Quadratic Equation												
-270 to 0	..	..	..	1.0619851	-2	-1.4972165	-6	..	..	..	..	-21 to 11
-200 to 0	..	..	..	1.4752564	-2	-8.4746756	-7	..	..	..	..	-3.9 to 2.3
-200 to 800	..	..	..	1.5595433	-2	-4.5934669	-8	..	..	..	..	-.60 to .20
-20 to 500	..	..	..	1.5607502	-2	-5.9146206	-8	..	..	..	..	-3 to 4
0 to 400	..	..	..	1.5957698	-2	-7.6656343	-8	..	..	..	..	-2 to 3
0 to 1000	..	..	..	1.4197624	-2	-1.6340830	-8	..	..	..	..	-8 to 13
400 to 1000	5.8687427	+1	..	1.1530864	-2	1.0276533	-8	..	..	..	..	-1.1 to 1.0
600 to 800	6.5319054	+1	..	1.1353750	-2	1.1231637	-8	..	..	..	..	-.03 to .03
850 to 1000	1.0476041	+2	..	1.0083242	-2	2.1492620	-8	..	..	..	..	-.005 to .007

A6. Supplementary Data for Type J—Iron Versus Copper–Nickel Alloy (SAMA) Thermocouples

A6.1. Data for Voltage as a Function of Temperature

The full precision coefficients given in the main text are used to generate the voltage as a function of temperature data given in tables A6.1.1 and A6.1.2. Table A6.1.1 presents the data in degrees Celsius from -210°C to 1200°C while table A6.1.2 presents the data in degrees Fahrenheit from -350°F to 2192°F . As discussed in section 6.2 of the text, the values given for Type J thermocouples above 760°C (1400°F) are not suitable for precise temperature measurements. Table A6.1.3 contains quadratic, cubic, and quartic approximations to the data as a function of temperature in selected temperature ranges. The error range given in the table is the difference between the voltage as obtained from the full precision coefficients from the text and the respective reduced order approximations. The last entries in the cubic and quadratic groupings of table A6.1.3 represent variable reference junction corrections in the 0 to 50°C temperature range. In the narrower temperature range near room temperatures, 20 to 25°C , the error range for the given *quadratic* equation is smaller than that listed in the last column: $\pm 0.2\ \mu\text{V}$.

TABLE A6.1.1. *Type J thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C*

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-210	-8.096											-210
-200	-7.890	-7.912	-7.934	-7.955	-7.976	-7.996	-8.017	-8.037	-8.057	-8.076	-8.096	-200
-190	-7.659	-7.683	-7.707	-7.731	-7.755	-7.778	-7.801	-7.824	-7.846	-7.868	-7.890	-190
-180	-7.402	-7.429	-7.455	-7.482	-7.508	-7.533	-7.559	-7.584	-7.609	-7.634	-7.659	-180
-170	-7.122	-7.151	-7.180	-7.209	-7.237	-7.265	-7.293	-7.321	-7.348	-7.375	-7.402	-170
-160	-6.821	-6.852	-6.883	-6.914	-6.944	-6.974	-7.004	-7.034	-7.064	-7.093	-7.122	-160
-150	-6.499	-6.532	-6.565	-6.598	-6.630	-6.663	-6.695	-6.727	-6.758	-6.790	-6.821	-150
-140	-6.159	-6.194	-6.228	-6.263	-6.297	-6.331	-6.365	-6.399	-6.433	-6.466	-6.499	-140
-130	-5.801	-5.837	-5.874	-5.910	-5.946	-5.982	-6.018	-6.053	-6.089	-6.124	-6.159	-130
-120	-5.426	-5.464	-5.502	-5.540	-5.578	-5.615	-5.653	-5.690	-5.727	-5.764	-5.801	-120
-110	-5.036	-5.076	-5.115	-5.155	-5.194	-5.233	-5.272	-5.311	-5.349	-5.388	-5.426	-110
-100	-4.632	-4.673	-4.714	-4.755	-4.795	-4.836	-4.876	-4.916	-4.956	-4.996	-5.036	-100
-90	-4.215	-4.257	-4.299	-4.341	-4.383	-4.425	-4.467	-4.508	-4.550	-4.591	-4.632	-90
-80	-3.785	-3.829	-3.872	-3.915	-3.958	-4.001	-4.044	-4.087	-4.130	-4.172	-4.215	-80
-70	-3.344	-3.389	-3.433	-3.478	-3.522	-3.566	-3.610	-3.654	-3.698	-3.742	-3.785	-70
-60	-2.892	-2.938	-2.984	-3.029	-3.074	-3.120	-3.165	-3.210	-3.255	-3.299	-3.344	-60
-50	-2.431	-2.478	-2.524	-2.570	-2.617	-2.663	-2.709	-2.755	-2.801	-2.847	-2.892	-50
-40	-1.960	-2.008	-2.055	-2.102	-2.150	-2.197	-2.244	-2.291	-2.338	-2.384	-2.431	-40
-30	-1.481	-1.530	-1.578	-1.626	-1.674	-1.722	-1.770	-1.818	-1.865	-1.913	-1.960	-30
-20	-0.995	-1.044	-1.093	-1.141	-1.190	-1.239	-1.288	-1.336	-1.385	-1.433	-1.481	-20
-10	-0.501	-0.550	-0.600	-0.650	-0.699	-0.748	-0.798	-0.847	-0.896	-0.945	-0.995	-10
-0	0.000	-0.050	-0.101	-0.151	-0.201	-0.251	-0.301	-0.351	-0.401	-0.451	-0.501	-0
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A6.1.1. Type J thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C—Continued

°C	0	1	2	3	4	5	6	7	8	9	10	°C
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	0.000	0.050	0.101	0.151	0.202	0.253	0.303	0.354	0.405	0.456	0.507	0
10	0.507	0.558	0.609	0.660	0.711	0.762	0.813	0.865	0.916	0.967	1.019	10
20	1.019	1.070	1.122	1.174	1.225	1.277	1.329	1.381	1.432	1.484	1.536	20
30	1.536	1.588	1.640	1.693	1.745	1.797	1.849	1.901	1.954	2.006	2.058	30
40	2.058	2.111	2.163	2.216	2.268	2.321	2.374	2.426	2.479	2.532	2.585	40
50	2.585	2.638	2.691	2.743	2.796	2.849	2.902	2.956	3.009	3.062	3.115	50
60	3.115	3.168	3.221	3.275	3.328	3.381	3.435	3.488	3.542	3.595	3.649	60
70	3.649	3.702	3.756	3.809	3.863	3.917	3.971	4.024	4.078	4.132	4.186	70
80	4.186	4.239	4.293	4.347	4.401	4.455	4.509	4.563	4.617	4.671	4.725	80
90	4.725	4.780	4.834	4.888	4.942	4.996	5.050	5.105	5.159	5.213	5.268	90
100	5.268	5.322	5.376	5.431	5.485	5.540	5.594	5.649	5.703	5.758	5.812	100
110	5.812	5.867	5.921	5.976	6.031	6.085	6.140	6.195	6.249	6.304	6.359	110
120	6.359	6.414	6.468	6.523	6.578	6.633	6.688	6.742	6.797	6.852	6.907	120
130	6.907	6.962	7.017	7.072	7.127	7.182	7.237	7.292	7.347	7.402	7.457	130
140	7.457	7.512	7.567	7.622	7.677	7.732	7.787	7.843	7.898	7.953	8.008	140
150	8.008	8.063	8.118	8.174	8.229	8.284	8.339	8.394	8.450	8.505	8.560	150
160	8.560	8.616	8.671	8.726	8.781	8.837	8.892	8.947	9.003	9.058	9.113	160
170	9.113	9.169	9.224	9.279	9.335	9.390	9.446	9.501	9.556	9.612	9.667	170
180	9.667	9.723	9.778	9.834	9.889	9.944	10.000	10.055	10.111	10.166	10.222	180
190	10.222	10.277	10.333	10.388	10.444	10.499	10.555	10.610	10.666	10.721	10.777	190
200	10.777	10.832	10.888	10.943	10.999	11.054	11.110	11.165	11.221	11.276	11.332	200
210	11.332	11.387	11.443	11.498	11.554	11.609	11.665	11.720	11.776	11.831	11.887	210
220	11.887	11.943	11.998	12.054	12.109	12.165	12.220	12.276	12.331	12.387	12.442	220
230	12.442	12.498	12.553	12.609	12.664	12.720	12.776	12.831	12.887	12.942	12.998	230
240	12.998	13.053	13.109	13.164	13.220	13.275	13.331	13.386	13.442	13.497	13.553	240
250	13.553	13.608	13.664	13.719	13.775	13.830	13.886	13.941	13.997	14.052	14.108	250
260	14.108	14.163	14.219	14.274	14.330	14.385	14.441	14.496	14.552	14.607	14.663	260
270	14.663	14.718	14.774	14.829	14.885	14.940	14.995	15.051	15.106	15.162	15.217	270
280	15.217	15.273	15.328	15.383	15.439	15.494	15.550	15.605	15.661	15.716	15.771	280
290	15.771	15.827	15.882	15.938	15.993	16.048	16.104	16.159	16.214	16.270	16.325	290
300	16.325	16.380	16.436	16.491	16.547	16.602	16.657	16.713	16.768	16.823	16.879	300
310	16.879	16.934	16.989	17.044	17.100	17.155	17.210	17.266	17.321	17.376	17.432	310
320	17.432	17.487	17.542	17.597	17.653	17.708	17.763	17.818	17.874	17.929	17.984	320
330	17.984	18.039	18.095	18.150	18.205	18.260	18.316	18.371	18.426	18.481	18.537	330
340	18.537	18.592	18.647	18.702	18.757	18.813	18.868	18.923	18.978	19.033	19.089	340
350	19.089	19.144	19.199	19.254	19.309	19.364	19.420	19.475	19.530	19.585	19.640	350
360	19.640	19.695	19.751	19.806	19.861	19.916	19.971	20.026	20.081	20.137	20.192	360
370	20.192	20.247	20.302	20.357	20.412	20.467	20.523	20.578	20.633	20.688	20.743	370
380	20.743	20.798	20.853	20.909	20.964	21.019	21.074	21.129	21.184	21.239	21.295	380
390	21.295	21.350	21.405	21.460	21.515	21.570	21.625	21.680	21.736	21.791	21.846	390
400	21.846	21.901	21.956	22.011	22.066	22.122	22.177	22.232	22.287	22.342	22.397	400
410	22.397	22.453	22.508	22.563	22.618	22.673	22.728	22.784	22.839	22.894	22.949	410
420	22.949	23.004	23.060	23.115	23.170	23.225	23.280	23.336	23.391	23.446	23.501	420
430	23.501	23.556	23.612	23.667	23.722	23.777	23.833	23.888	23.943	23.999	24.054	430
440	24.054	24.109	24.164	24.220	24.275	24.330	24.386	24.441	24.496	24.552	24.607	440
450	24.607	24.662	24.718	24.773	24.829	24.884	24.939	24.995	25.050	25.106	25.161	450
460	25.161	25.217	25.272	25.327	25.383	25.438	25.494	25.549	25.605	25.661	25.716	460
470	25.716	25.772	25.827	25.883	25.938	25.994	26.050	26.105	26.161	26.216	26.272	470
480	26.272	26.328	26.383	26.439	26.495	26.551	26.606	26.662	26.718	26.774	26.829	480
490	26.829	26.885	26.941	26.997	27.053	27.109	27.165	27.220	27.276	27.332	27.388	490
500	27.388	27.444	27.500	27.556	27.612	27.668	27.724	27.780	27.836	27.893	27.949	500
510	27.949	28.005	28.061	28.117	28.173	28.230	28.286	28.342	28.398	28.455	28.511	510
520	28.511	28.567	28.624	28.680	28.736	28.793	28.849	28.906	28.962	29.019	29.075	520
530	29.075	29.132	29.188	29.245	29.301	29.358	29.415	29.471	29.528	29.585	29.642	530
540	29.642	29.698	29.755	29.812	29.869	29.926	29.983	30.039	30.096	30.153	30.210	540
550	30.210	30.267	30.324	30.381	30.439	30.496	30.553	30.610	30.667	30.724	30.782	550
560	30.782	30.839	30.896	30.954	31.011	31.068	31.126	31.183	31.241	31.298	31.356	560
570	31.356	31.413	31.471	31.528	31.586	31.644	31.702	31.759	31.817	31.875	31.933	570
580	31.933	31.991	32.048	32.106	32.164	32.222	32.280	32.338	32.396	32.455	32.513	580
590	32.513	32.571	32.629	32.687	32.746	32.804	32.862	32.921	32.979	33.038	33.096	590
600	33.096	33.155	33.213	33.272	33.330	33.389	33.448	33.506	33.565	33.624	33.683	600
°C	0	1	2	3	4	5	6	7	8	9	10	°C

TABLE A6.1.1. Type J thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C—Continued

°C	0	1	2	3	4	5	6	7	8	9	10	°C
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	33.096	33.155	33.213	33.272	33.330	33.389	33.448	33.506	33.565	33.624	33.683	600
610	33.683	33.742	33.800	33.859	33.918	33.977	34.036	34.095	34.155	34.214	34.273	610
620	34.273	34.332	34.391	34.451	34.510	34.569	34.629	34.688	34.748	34.807	34.867	620
630	34.867	34.926	34.986	35.046	35.105	35.165	35.225	35.285	35.344	35.404	35.464	630
640	35.464	35.524	35.584	35.644	35.704	35.764	35.825	35.885	35.945	36.005	36.066	640
650	36.066	36.126	36.186	36.247	36.307	36.368	36.428	36.489	36.549	36.610	36.671	650
660	36.671	36.732	36.792	36.853	36.914	36.975	37.036	37.097	37.158	37.219	37.280	660
670	37.280	37.341	37.402	37.463	37.525	37.586	37.647	37.709	37.770	37.831	37.893	670
680	37.893	37.954	38.016	38.078	38.139	38.201	38.262	38.324	38.386	38.448	38.510	680
690	38.510	38.572	38.633	38.695	38.757	38.819	38.882	38.944	39.006	39.068	39.130	690
700	39.130	39.192	39.255	39.317	39.379	39.442	39.504	39.567	39.629	39.692	39.754	700
710	39.754	39.817	39.880	39.942	40.005	40.068	40.131	40.193	40.256	40.319	40.382	710
720	40.382	40.445	40.508	40.571	40.634	40.697	40.760	40.823	40.886	40.950	41.013	720
730	41.013	41.076	41.139	41.203	41.266	41.329	41.393	41.456	41.520	41.583	41.647	730
740	41.647	41.710	41.774	41.837	41.901	41.965	42.028	42.092	42.156	42.219	42.283	740
750	42.283	42.347	42.411	42.475	42.538	42.602	42.666	42.730	42.794	42.858	42.922	750
760	42.922											760
°C	0	1	2	3	4	5	6	7	8	9	10	°C

TABLE A6.1.1. *Type J thermocouples extended range—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C*

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
760	42.922	42.986	43.050	43.114	43.178	43.242	43.306	43.370	43.435	43.499	43.563	760
770	43.563	43.627	43.692	43.756	43.820	43.885	43.949	44.014	44.078	44.142	44.207	770
780	44.207	44.271	44.336	44.400	44.465	44.529	44.594	44.658	44.723	44.788	44.852	780
790	44.852	44.917	44.981	45.046	45.111	45.175	45.240	45.304	45.369	45.434	45.498	790
800	45.498	45.563	45.627	45.692	45.757	45.821	45.886	45.950	46.015	46.080	46.144	800
810	46.144	46.209	46.273	46.338	46.403	46.467	46.532	46.596	46.661	46.725	46.790	810
820	46.790	46.854	46.919	46.983	47.047	47.112	47.176	47.241	47.305	47.369	47.434	820
830	47.434	47.498	47.562	47.627	47.691	47.755	47.819	47.884	47.948	48.012	48.076	830
840	48.076	48.140	48.204	48.269	48.333	48.397	48.461	48.525	48.589	48.653	48.716	840
850	48.716	48.780	48.844	48.908	48.972	49.036	49.099	49.163	49.227	49.291	49.354	850
860	49.354	49.418	49.481	49.545	49.608	49.672	49.735	49.799	49.862	49.926	49.989	860
870	49.989	50.052	50.116	50.179	50.242	50.305	50.369	50.432	50.495	50.558	50.621	870
880	50.621	50.684	50.747	50.810	50.873	50.936	50.998	51.061	51.124	51.187	51.249	880
890	51.249	51.312	51.375	51.437	51.500	51.562	51.625	51.687	51.750	51.812	51.875	890
900	51.875	51.937	51.999	52.061	52.124	52.186	52.248	52.310	52.372	52.434	52.496	900
910	52.496	52.558	52.620	52.682	52.744	52.806	52.868	52.929	52.991	53.053	53.115	910
920	53.115	53.176	53.238	53.299	53.361	53.422	53.484	53.545	53.607	53.668	53.729	920
930	53.729	53.791	53.852	53.913	53.974	54.035	54.096	54.157	54.219	54.280	54.341	930
940	54.341	54.401	54.462	54.523	54.584	54.645	54.706	54.766	54.827	54.888	54.948	940
950	54.948	55.009	55.070	55.130	55.191	55.251	55.312	55.372	55.432	55.493	55.553	950
960	55.553	55.613	55.674	55.734	55.794	55.854	55.914	55.974	56.035	56.095	56.155	960
970	56.155	56.215	56.275	56.334	56.394	56.454	56.514	56.574	56.634	56.693	56.753	970
980	56.753	56.813	56.873	56.932	56.992	57.051	57.111	57.170	57.230	57.289	57.349	980
990	57.349	57.408	57.468	57.527	57.586	57.646	57.705	57.764	57.824	57.883	57.942	990
1,000	57.942	58.001	58.060	58.120	58.179	58.238	58.297	58.356	58.415	58.474	58.533	1,000
1,010	58.533	58.592	58.651	58.710	58.769	58.827	58.886	58.945	59.004	59.063	59.121	1,010
1,020	59.121	59.180	59.239	59.298	59.356	59.415	59.474	59.532	59.591	59.650	59.708	1,020
1,030	59.708	59.767	59.825	59.884	59.942	60.001	60.059	60.118	60.176	60.235	60.293	1,030
1,040	60.293	60.351	60.410	60.468	60.527	60.585	60.643	60.702	60.760	60.818	60.876	1,040
1,050	60.876	60.935	60.993	61.051	61.109	61.168	61.226	61.284	61.342	61.400	61.459	1,050
1,060	61.459	61.517	61.575	61.633	61.691	61.749	61.807	61.865	61.923	61.981	62.039	1,060
1,070	62.039	62.097	62.156	62.214	62.272	62.330	62.388	62.446	62.504	62.562	62.619	1,070
1,080	62.619	62.677	62.735	62.793	62.851	62.909	62.967	63.025	63.083	63.141	63.199	1,080
1,090	63.199	63.257	63.314	63.372	63.430	63.488	63.546	63.604	63.662	63.719	63.777	1,090
1,100	63.777	63.835	63.893	63.951	64.009	64.066	64.124	64.182	64.240	64.298	64.355	1,100
1,110	64.355	64.413	64.471	64.529	64.586	64.644	64.702	64.760	64.817	64.875	64.933	1,110
1,120	64.933	64.991	65.048	65.106	65.164	65.222	65.279	65.337	65.395	65.453	65.510	1,120
1,130	65.510	65.568	65.626	65.683	65.741	65.799	65.856	65.914	65.972	66.029	66.087	1,130
1,140	66.087	66.145	66.202	66.260	66.318	66.375	66.433	66.491	66.548	66.606	66.664	1,140
1,150	66.664	66.721	66.779	66.836	66.894	66.952	67.009	67.067	67.124	67.182	67.240	1,150
1,160	67.240	67.297	67.355	67.412	67.470	67.527	67.585	67.643	67.700	67.758	67.815	1,160
1,170	67.815	67.873	67.930	67.988	68.045	68.103	68.160	68.217	68.275	68.332	68.390	1,170
1,180	68.390	68.447	68.505	68.562	68.619	68.677	68.734	68.792	68.849	68.906	68.964	1,180
1,190	68.964	69.021	69.078	69.135	69.193	69.250	69.307	69.364	69.422	69.479	69.536	1,190
1,200	69.536											1,200
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A6.1.2. *Type J thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-350	-8.137											-350
-340	-8.030	-8.041	-8.052	-8.063	-8.074	-8.085	-8.096	-8.106	-8.117	-8.127	-8.137	-340
-330	-7.915	-7.927	-7.938	-7.950	-7.962	-7.973	-7.985	-7.996	-8.008	-8.019	-8.030	-330
-320	-7.791	-7.803	-7.816	-7.829	-7.841	-7.854	-7.866	-7.878	-7.890	-7.903	-7.915	-320
-310	-7.659	-7.672	-7.686	-7.699	-7.712	-7.726	-7.739	-7.752	-7.765	-7.778	-7.791	-310
-300	-7.519	-7.533	-7.548	-7.562	-7.576	-7.590	-7.604	-7.618	-7.631	-7.645	-7.659	-300
-290	-7.372	-7.387	-7.402	-7.417	-7.432	-7.447	-7.461	-7.476	-7.490	-7.505	-7.519	-290
-280	-7.218	-7.234	-7.250	-7.265	-7.281	-7.296	-7.311	-7.327	-7.342	-7.357	-7.372	-280
-270	-7.057	-7.074	-7.090	-7.106	-7.122	-7.139	-7.155	-7.171	-7.187	-7.202	-7.218	-270
-260	-6.890	-6.907	-6.924	-6.941	-6.958	-6.974	-6.991	-7.008	-7.024	-7.041	-7.057	-260
-250	-6.716	-6.734	-6.751	-6.769	-6.786	-6.804	-6.821	-6.838	-6.856	-6.873	-6.890	-250
-240	-6.536	-6.554	-6.572	-6.591	-6.609	-6.627	-6.645	-6.663	-6.680	-6.698	-6.716	-240
-230	-6.350	-6.369	-6.388	-6.407	-6.425	-6.444	-6.462	-6.481	-6.499	-6.518	-6.536	-230
-220	-6.159	-6.178	-6.198	-6.217	-6.236	-6.255	-6.274	-6.293	-6.312	-6.331	-6.350	-220
-210	-5.962	-5.982	-6.002	-6.022	-6.041	-6.061	-6.081	-6.100	-6.120	-6.139	-6.159	-210
-200	-5.760	-5.780	-5.801	-5.821	-5.841	-5.861	-5.882	-5.902	-5.922	-5.942	-5.962	-200
-190	-5.553	-5.574	-5.594	-5.615	-5.636	-5.657	-5.678	-5.698	-5.719	-5.739	-5.760	-190
-180	-5.341	-5.362	-5.383	-5.405	-5.426	-5.447	-5.468	-5.490	-5.511	-5.532	-5.553	-180
-170	-5.124	-5.146	-5.168	-5.190	-5.211	-5.233	-5.255	-5.276	-5.298	-5.319	-5.341	-170
-160	-4.903	-4.925	-4.948	-4.970	-4.992	-5.014	-5.036	-5.058	-5.080	-5.102	-5.124	-160
-150	-4.678	-4.700	-4.723	-4.746	-4.768	-4.791	-4.813	-4.836	-4.858	-4.881	-4.903	-150
-140	-4.448	-4.471	-4.494	-4.517	-4.540	-4.563	-4.586	-4.609	-4.632	-4.655	-4.678	-140
-130	-4.215	-4.238	-4.262	-4.285	-4.309	-4.332	-4.355	-4.379	-4.402	-4.425	-4.448	-130
-120	-3.978	-4.001	-4.025	-4.049	-4.073	-4.097	-4.120	-4.144	-4.168	-4.191	-4.215	-120
-110	-3.737	-3.761	-3.785	-3.809	-3.833	-3.858	-3.882	-3.906	-3.930	-3.954	-3.978	-110
-100	-3.492	-3.517	-3.541	-3.566	-3.590	-3.615	-3.639	-3.664	-3.688	-3.712	-3.737	-100
-90	-3.245	-3.270	-3.294	-3.319	-3.344	-3.369	-3.394	-3.418	-3.443	-3.468	-3.492	-90
-80	-2.994	-3.019	-3.044	-3.069	-3.094	-3.120	-3.145	-3.170	-3.195	-3.220	-3.245	-80
-70	-2.740	-2.765	-2.791	-2.816	-2.842	-2.867	-2.892	-2.918	-2.943	-2.968	-2.994	-70
-60	-2.483	-2.509	-2.534	-2.560	-2.586	-2.612	-2.637	-2.663	-2.689	-2.714	-2.740	-60
-50	-2.223	-2.249	-2.275	-2.301	-2.327	-2.353	-2.379	-2.405	-2.431	-2.457	-2.483	-50
-40	-1.960	-1.987	-2.013	-2.039	-2.066	-2.092	-2.118	-2.144	-2.171	-2.197	-2.223	-40
-30	-1.695	-1.722	-1.748	-1.775	-1.802	-1.828	-1.855	-1.881	-1.908	-1.934	-1.960	-30
-20	-1.428	-1.455	-1.481	-1.508	-1.535	-1.562	-1.589	-1.615	-1.642	-1.669	-1.695	-20
-10	-1.158	-1.185	-1.212	-1.239	-1.266	-1.293	-1.320	-1.347	-1.374	-1.401	-1.428	-10
0	-0.885	-0.913	-0.940	-0.967	-0.995	-1.022	-1.049	-1.076	-1.103	-1.131	-1.158	0
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A6.1.2. Type J thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	-0.885	-0.858	-0.831	-0.803	-0.776	-0.748	-0.721	-0.694	-0.666	-0.639	-0.611	0
10	-0.611	-0.583	-0.556	-0.528	-0.501	-0.473	-0.445	-0.418	-0.390	-0.362	-0.334	10
20	-0.334	-0.307	-0.279	-0.251	-0.223	-0.195	-0.168	-0.140	-0.112	-0.084	-0.056	20
30	-0.056	-0.028	0.000	0.028	0.056	0.084	0.112	0.140	0.168	0.196	0.224	30
40	0.224	0.253	0.281	0.309	0.337	0.365	0.394	0.422	0.450	0.478	0.507	40
50	0.507	0.535	0.563	0.592	0.620	0.648	0.677	0.705	0.734	0.762	0.791	50
60	0.791	0.819	0.848	0.876	0.905	0.933	0.962	0.990	1.019	1.048	1.076	60
70	1.076	1.105	1.134	1.162	1.191	1.220	1.248	1.277	1.306	1.335	1.363	70
80	1.363	1.392	1.421	1.450	1.479	1.507	1.536	1.565	1.594	1.623	1.652	80
90	1.652	1.681	1.710	1.739	1.768	1.797	1.826	1.855	1.884	1.913	1.942	90
100	1.942	1.971	2.000	2.029	2.058	2.088	2.117	2.146	2.175	2.204	2.233	100
110	2.233	2.263	2.292	2.321	2.350	2.380	2.409	2.438	2.467	2.497	2.526	110
120	2.526	2.555	2.585	2.614	2.644	2.673	2.702	2.732	2.761	2.791	2.820	120
130	2.820	2.849	2.879	2.908	2.938	2.967	2.997	3.026	3.056	3.085	3.115	130
140	3.115	3.145	3.174	3.204	3.233	3.263	3.293	3.322	3.352	3.381	3.411	140
150	3.411	3.441	3.470	3.500	3.530	3.560	3.589	3.619	3.649	3.678	3.708	150
160	3.708	3.738	3.768	3.798	3.827	3.857	3.887	3.917	3.947	3.976	4.006	160
170	4.006	4.036	4.066	4.096	4.126	4.156	4.186	4.216	4.245	4.275	4.305	170
180	4.305	4.335	4.365	4.395	4.425	4.455	4.485	4.515	4.545	4.575	4.605	180
190	4.605	4.635	4.665	4.695	4.725	4.755	4.786	4.816	4.846	4.876	4.906	190
200	4.906	4.936	4.966	4.996	5.026	5.057	5.087	5.117	5.147	5.177	5.207	200
210	5.207	5.238	5.268	5.298	5.328	5.358	5.389	5.419	5.449	5.479	5.509	210
220	5.509	5.540	5.570	5.600	5.630	5.661	5.691	5.721	5.752	5.782	5.812	220
230	5.812	5.843	5.873	5.903	5.934	5.964	5.994	6.025	6.055	6.085	6.116	230
240	6.116	6.146	6.176	6.207	6.237	6.268	6.298	6.328	6.359	6.389	6.420	240
250	6.420	6.450	6.481	6.511	6.541	6.572	6.602	6.633	6.663	6.694	6.724	250
260	6.724	6.755	6.785	6.816	6.846	6.877	6.907	6.938	6.968	6.999	7.029	260
270	7.029	7.060	7.090	7.121	7.151	7.182	7.212	7.243	7.274	7.304	7.335	270
280	7.335	7.365	7.396	7.426	7.457	7.488	7.518	7.549	7.579	7.610	7.641	280
290	7.641	7.671	7.702	7.732	7.763	7.794	7.824	7.855	7.885	7.916	7.947	290
300	7.947	7.977	8.008	8.039	8.069	8.100	8.131	8.161	8.192	8.223	8.253	300
310	8.253	8.284	8.315	8.345	8.376	8.407	8.437	8.468	8.499	8.530	8.560	310
320	8.560	8.591	8.622	8.652	8.683	8.714	8.745	8.775	8.806	8.837	8.867	320
330	8.867	8.898	8.929	8.960	8.990	9.021	9.052	9.083	9.113	9.144	9.175	330
340	9.175	9.206	9.236	9.267	9.298	9.329	9.359	9.390	9.421	9.452	9.483	340
350	9.483	9.513	9.544	9.575	9.606	9.636	9.667	9.698	9.729	9.760	9.790	350
360	9.790	9.821	9.852	9.883	9.914	9.944	9.975	10.006	10.037	10.068	10.098	360
370	10.098	10.129	10.160	10.191	10.222	10.252	10.283	10.314	10.345	10.376	10.407	370
380	10.407	10.437	10.468	10.499	10.530	10.561	10.592	10.622	10.653	10.684	10.715	380
390	10.715	10.746	10.777	10.807	10.838	10.869	10.900	10.931	10.962	10.992	11.023	390
400	11.023	11.054	11.085	11.116	11.147	11.177	11.208	11.239	11.270	11.301	11.332	400
410	11.332	11.363	11.393	11.424	11.455	11.486	11.517	11.548	11.578	11.609	11.640	410
420	11.640	11.671	11.702	11.733	11.764	11.794	11.825	11.856	11.887	11.918	11.949	420
430	11.949	11.980	12.010	12.041	12.072	12.103	12.134	12.165	12.196	12.226	12.257	430
440	12.257	12.288	12.319	12.350	12.381	12.411	12.442	12.473	12.504	12.535	12.566	440
450	12.566	12.597	12.627	12.658	12.689	12.720	12.751	12.782	12.813	12.843	12.874	450
460	12.874	12.905	12.936	12.967	12.998	13.029	13.059	13.090	13.121	13.152	13.183	460
470	13.183	13.214	13.244	13.275	13.306	13.337	13.368	13.399	13.430	13.460	13.491	470
480	13.491	13.522	13.553	13.584	13.615	13.645	13.676	13.707	13.738	13.769	13.800	480
490	13.800	13.830	13.861	13.892	13.923	13.954	13.985	14.015	14.046	14.077	14.108	490
500	14.108	14.139	14.170	14.200	14.231	14.262	14.293	14.324	14.355	14.385	14.416	500
510	14.416	14.447	14.478	14.509	14.539	14.570	14.601	14.632	14.663	14.694	14.724	510
520	14.724	14.755	14.786	14.817	14.848	14.878	14.909	14.940	14.971	15.002	15.032	520
530	15.032	15.063	15.094	15.125	15.156	15.186	15.217	15.248	15.279	15.310	15.340	530
540	15.340	15.371	15.402	15.433	15.464	15.494	15.525	15.556	15.587	15.617	15.648	540
550	15.648	15.679	15.710	15.741	15.771	15.802	15.833	15.864	15.894	15.925	15.956	550
560	15.956	15.987	16.018	16.048	16.079	16.110	16.141	16.171	16.202	16.233	16.264	560
570	16.264	16.294	16.325	16.356	16.387	16.417	16.448	16.479	16.510	16.540	16.571	570
580	16.571	16.602	16.633	16.663	16.694	16.725	16.756	16.786	16.817	16.848	16.879	580
590	16.879	16.909	16.940	16.971	17.001	17.032	17.063	17.094	17.124	17.155	17.186	590
600	17.186	17.217	17.247	17.278	17.309	17.339	17.370	17.401	17.432	17.462	17.493	600
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A6.1.2. *Type J thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	17.186	17.217	17.247	17.278	17.309	17.339	17.370	17.401	17.432	17.462	17.493	600
610	17.493	17.524	17.554	17.585	17.616	17.646	17.677	17.708	17.739	17.769	17.800	610
620	17.800	17.831	17.861	17.892	17.923	17.953	17.984	18.015	18.046	18.076	18.107	620
630	18.107	18.138	18.168	18.199	18.230	18.260	18.291	18.322	18.352	18.383	18.414	630
640	18.414	18.444	18.475	18.506	18.537	18.567	18.598	18.629	18.659	18.690	18.721	640
650	18.721	18.751	18.782	18.813	18.843	18.874	18.905	18.935	18.966	18.997	19.027	650
660	19.027	19.058	19.089	19.119	19.150	19.180	19.211	19.242	19.272	19.303	19.334	660
670	19.334	19.364	19.395	19.426	19.456	19.487	19.518	19.548	19.579	19.610	19.640	670
680	19.640	19.671	19.702	19.732	19.763	19.793	19.824	19.855	19.885	19.916	19.947	680
690	19.947	19.977	20.008	20.039	20.069	20.100	20.131	20.161	20.192	20.222	20.253	690
700	20.253	20.284	20.314	20.345	20.376	20.406	20.437	20.467	20.498	20.529	20.559	700
710	20.559	20.590	20.621	20.651	20.682	20.713	20.743	20.774	20.804	20.835	20.866	710
720	20.866	20.896	20.927	20.958	20.988	21.019	21.049	21.080	21.111	21.141	21.172	720
730	21.172	21.203	21.233	21.264	21.295	21.325	21.356	21.386	21.417	21.448	21.478	730
740	21.478	21.509	21.540	21.570	21.601	21.631	21.662	21.693	21.723	21.754	21.785	740
750	21.785	21.815	21.846	21.877	21.907	21.938	21.968	21.999	22.030	22.060	22.091	750
760	22.091	22.122	22.152	22.183	22.214	22.244	22.275	22.305	22.336	22.367	22.397	760
770	22.397	22.428	22.459	22.489	22.520	22.551	22.581	22.612	22.643	22.673	22.704	770
780	22.704	22.735	22.765	22.796	22.826	22.857	22.888	22.918	22.949	22.980	23.010	780
790	23.010	23.041	23.072	23.102	23.133	23.164	23.194	23.225	23.256	23.286	23.317	790
800	23.317	23.348	23.378	23.409	23.440	23.471	23.501	23.532	23.563	23.593	23.624	800
810	23.624	23.655	23.685	23.716	23.747	23.777	23.808	23.839	23.870	23.900	23.931	810
820	23.931	23.962	23.992	24.023	24.054	24.085	24.115	24.146	24.177	24.207	24.238	820
830	24.238	24.269	24.300	24.330	24.361	24.392	24.423	24.453	24.484	24.515	24.546	830
840	24.546	24.576	24.607	24.638	24.669	24.699	24.730	24.761	24.792	24.822	24.853	840
850	24.853	24.884	24.915	24.946	24.976	25.007	25.038	25.069	25.099	25.130	25.161	850
860	25.161	25.192	25.223	25.254	25.284	25.315	25.346	25.377	25.408	25.438	25.469	860
870	25.469	25.500	25.531	25.562	25.593	25.623	25.654	25.685	25.716	25.747	25.778	870
880	25.778	25.809	25.840	25.870	25.901	25.932	25.963	25.994	26.025	26.056	26.087	880
890	26.087	26.118	26.148	26.179	26.210	26.241	26.272	26.303	26.334	26.365	26.396	890
900	26.396	26.427	26.458	26.489	26.520	26.551	26.582	26.613	26.644	26.675	26.705	900
910	26.705	26.736	26.767	26.798	26.829	26.860	26.891	26.922	26.953	26.984	27.015	910
920	27.015	27.046	27.077	27.108	27.139	27.170	27.201	27.232	27.263	27.294	27.325	920
930	27.325	27.356	27.387	27.418	27.449	27.480	27.511	27.542	27.573	27.604	27.635	930
940	27.635	27.666	27.697	27.728	27.759	27.790	27.821	27.852	27.883	27.914	27.945	940
950	27.945	27.976	28.007	28.038	28.069	28.100	28.131	28.162	28.193	28.224	28.255	950
960	28.255	28.286	28.317	28.348	28.379	28.410	28.441	28.472	28.503	28.534	28.565	960
970	28.565	28.596	28.627	28.658	28.689	28.720	28.751	28.782	28.813	28.844	28.875	970
980	28.875	28.906	28.937	28.968	29.000	29.031	29.062	29.093	29.124	29.155	29.186	980
990	29.186	29.217	29.248	29.279	29.310	29.341	29.372	29.403	29.434	29.465	29.496	990
1,000	29.515	29.547	29.578	29.610	29.642	29.673	29.705	29.736	29.768	29.799	29.831	1,000
1,010	29.831	29.862	29.894	29.926	29.957	29.989	30.020	30.052	30.084	30.115	30.147	1,010
1,020	30.147	30.179	30.210	30.242	30.274	30.305	30.337	30.369	30.400	30.432	30.464	1,020
1,030	30.464	30.496	30.527	30.559	30.591	30.623	30.654	30.686	30.718	30.750	30.782	1,030
1,040	30.782	30.813	30.845	30.877	30.909	30.941	30.973	31.005	31.036	31.068	31.100	1,040
1,050	31.100	31.132	31.164	31.196	31.228	31.260	31.292	31.324	31.356	31.388	31.420	1,050
1,060	31.420	31.452	31.484	31.516	31.548	31.580	31.612	31.644	31.676	31.708	31.740	1,060
1,070	31.740	31.772	31.804	31.836	31.868	31.901	31.933	31.965	31.997	32.029	32.061	1,070
1,080	32.061	32.094	32.126	32.158	32.190	32.222	32.255	32.287	32.319	32.351	32.384	1,080
1,090	32.384	32.416	32.448	32.480	32.513	32.545	32.577	32.610	32.642	32.674	32.707	1,090
1,100	32.707	32.739	32.772	32.804	32.836	32.869	32.901	32.934	32.966	32.999	33.031	1,100
1,110	33.031	33.064	33.096	33.129	33.161	33.194	33.226	33.259	33.291	33.324	33.356	1,110
1,120	33.356	33.389	33.422	33.454	33.487	33.519	33.552	33.585	33.617	33.650	33.683	1,120
1,130	33.683	33.715	33.748	33.781	33.814	33.846	33.879	33.912	33.945	33.977	34.010	1,130
1,140	34.010	34.043	34.076	34.109	34.141	34.174	34.207	34.240	34.273	34.306	34.339	1,140
1,150	34.339	34.372	34.405	34.437	34.470	34.503	34.536	34.569	34.602	34.635	34.668	1,150
1,160	34.668	34.701	34.734	34.767	34.801	34.834	34.867	34.900	34.933	34.966	34.999	1,160
1,170	34.999	35.032	35.065	35.099	35.132	35.165	35.198	35.231	35.265	35.298	35.331	1,170
1,180	35.331	35.364	35.398	35.431	35.464	35.498	35.531	35.564	35.598	35.631	35.664	1,180
1,190	35.664	35.698	35.731	35.764	35.798	35.831	35.865	35.898	35.932	35.965	35.999	1,190
1,200	35.999	36.032	36.066	36.099	36.133	36.166	36.200	36.233	36.267	36.301	36.334	1,200
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A6.1.2. *Type J thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,200	35.999	36.032	36.066	36.099	36.133	36.166	36.200	36.233	36.267	36.301	36.334	1,200
1,210	36.334	36.368	36.401	36.435	36.469	36.502	36.536	36.570	36.603	36.637	36.671	1,210
1,220	36.671	36.705	36.738	36.772	36.806	36.840	36.873	36.907	36.941	36.975	37.009	1,220
1,230	37.009	37.043	37.076	37.110	37.144	37.178	37.212	37.246	37.280	37.314	37.348	1,230
1,240	37.348	37.382	37.416	37.450	37.484	37.518	37.552	37.586	37.620	37.654	37.688	1,240
1,250	37.688	37.722	37.756	37.790	37.825	37.859	37.893	37.927	37.961	37.995	38.030	1,250
1,260	38.030	38.064	38.098	38.132	38.167	38.201	38.235	38.269	38.304	38.338	38.372	1,260
1,270	38.372	38.407	38.441	38.475	38.510	38.544	38.578	38.613	38.647	38.682	38.716	1,270
1,280	38.716	38.751	38.785	38.819	38.854	38.888	38.923	38.957	38.992	39.027	39.061	1,280
1,290	39.061	39.096	39.130	39.165	39.199	39.234	39.269	39.303	39.338	39.373	39.407	1,290
1,300	39.407	39.442	39.477	39.511	39.546	39.581	39.615	39.650	39.685	39.720	39.754	1,300
1,310	39.754	39.789	39.824	39.859	39.894	39.928	39.963	39.998	40.033	40.068	40.103	1,310
1,320	40.103	40.138	40.172	40.207	40.242	40.277	40.312	40.347	40.382	40.417	40.452	1,320
1,330	40.452	40.487	40.522	40.557	40.592	40.627	40.662	40.697	40.732	40.767	40.802	1,330
1,340	40.802	40.837	40.872	40.908	40.943	40.978	41.013	41.048	41.083	41.118	41.154	1,340
1,350	41.154	41.189	41.224	41.259	41.294	41.329	41.365	41.400	41.435	41.470	41.506	1,350
1,360	41.506	41.541	41.576	41.611	41.647	41.682	41.717	41.753	41.788	41.823	41.859	1,360
1,370	41.859	41.894	41.929	41.965	42.000	42.035	42.071	42.106	42.142	42.177	42.212	1,370
1,380	42.212	42.248	42.283	42.319	42.354	42.390	42.425	42.460	42.496	42.531	42.567	1,380
1,390	42.567	42.602	42.638	42.673	42.709	42.744	42.780	42.815	42.851	42.886	42.922	1,390
1,400	42.922											1,400
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A6.1.2. *Type J thermocouples extended range—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,400	42.922	42.957	42.993	43.029	43.064	43.100	43.135	43.171	43.207	43.242	43.278	1,400
1,410	43.278	43.313	43.349	43.385	43.420	43.456	43.492	43.527	43.563	43.599	43.635	1,410
1,420	43.635	43.670	43.706	43.742	43.777	43.813	43.849	43.885	43.921	43.956	43.992	1,420
1,430	43.992	44.028	44.064	44.099	44.135	44.171	44.207	44.243	44.279	44.314	44.350	1,430
1,440	44.350	44.386	44.422	44.458	44.494	44.529	44.565	44.601	44.637	44.673	44.709	1,440
1,450	44.709	44.745	44.780	44.816	44.852	44.888	44.924	44.960	44.996	45.032	45.067	1,450
1,460	45.067	45.103	45.139	45.175	45.211	45.247	45.283	45.319	45.355	45.391	45.426	1,460
1,470	45.426	45.462	45.498	45.534	45.570	45.606	45.642	45.678	45.714	45.749	45.785	1,470
1,480	45.785	45.821	45.857	45.893	45.929	45.965	46.001	46.037	46.072	46.108	46.144	1,480
1,490	46.144	46.180	46.216	46.252	46.288	46.324	46.359	46.395	46.431	46.467	46.503	1,490
1,500	46.503	46.539	46.575	46.610	46.646	46.682	46.718	46.754	46.790	46.825	46.861	1,500
1,510	46.861	46.897	46.933	46.969	47.005	47.040	47.076	47.112	47.148	47.183	47.219	1,510
1,520	47.219	47.255	47.291	47.327	47.362	47.398	47.434	47.470	47.505	47.541	47.577	1,520
1,530	47.577	47.612	47.648	47.684	47.720	47.755	47.791	47.827	47.862	47.898	47.934	1,530
1,540	47.934	47.969	48.005	48.041	48.076	48.112	48.147	48.183	48.219	48.254	48.290	1,540
1,550	48.290	48.325	48.361	48.397	48.432	48.468	48.503	48.539	48.574	48.610	48.645	1,550
1,560	48.645	48.681	48.716	48.752	48.787	48.823	48.858	48.894	48.929	48.965	49.000	1,560
1,570	49.000	49.036	49.071	49.107	49.142	49.177	49.213	49.248	49.283	49.319	49.354	1,570
1,580	49.354	49.390	49.425	49.460	49.496	49.531	49.566	49.601	49.637	49.672	49.707	1,580
1,590	49.707	49.743	49.778	49.813	49.848	49.883	49.919	49.954	49.989	50.024	50.059	1,590
1,600	50.059	50.095	50.130	50.165	50.200	50.235	50.270	50.305	50.340	50.376	50.411	1,600
1,610	50.411	50.446	50.481	50.516	50.551	50.586	50.621	50.656	50.691	50.726	50.761	1,610
1,620	50.761	50.796	50.831	50.866	50.901	50.936	50.970	51.005	51.040	51.075	51.110	1,620
1,630	51.110	51.145	51.180	51.215	51.249	51.284	51.319	51.354	51.389	51.423	51.458	1,630
1,640	51.458	51.493	51.528	51.562	51.597	51.632	51.667	51.701	51.736	51.771	51.805	1,640
1,650	51.805	51.840	51.875	51.909	51.944	51.978	52.013	52.048	52.082	52.117	52.151	1,650
1,660	52.151	52.186	52.220	52.255	52.289	52.324	52.358	52.393	52.427	52.462	52.496	1,660
1,670	52.496	52.531	52.565	52.600	52.634	52.668	52.703	52.737	52.772	52.806	52.840	1,670
1,680	52.840	52.875	52.909	52.943	52.977	53.012	53.046	53.080	53.115	53.149	53.183	1,680
1,690	53.183	53.217	53.251	53.286	53.320	53.354	53.388	53.422	53.456	53.491	53.525	1,690
1,700	53.525	53.559	53.593	53.627	53.661	53.695	53.729	53.763	53.797	53.831	53.865	1,700
1,710	53.865	53.899	53.933	53.967	54.001	54.035	54.069	54.103	54.137	54.171	54.205	1,710
1,720	54.205	54.239	54.273	54.307	54.341	54.374	54.408	54.442	54.476	54.510	54.544	1,720
1,730	54.544	54.577	54.611	54.645	54.679	54.712	54.746	54.780	54.814	54.847	54.881	1,730
1,740	54.881	54.915	54.948	54.982	55.016	55.049	55.083	55.117	55.150	55.184	55.218	1,740
1,750	55.218	55.251	55.285	55.318	55.352	55.385	55.419	55.453	55.486	55.520	55.553	1,750
1,760	55.553	55.587	55.620	55.654	55.687	55.720	55.754	55.787	55.821	55.854	55.888	1,760
1,770	55.888	55.921	55.954	55.988	56.021	56.055	56.088	56.121	56.155	56.188	56.221	1,770
1,780	56.221	56.255	56.288	56.321	56.354	56.388	56.421	56.454	56.487	56.521	56.554	1,780
1,790	56.554	56.587	56.620	56.654	56.687	56.720	56.753	56.786	56.819	56.853	56.886	1,790
1,800	56.886	56.919	56.952	56.985	57.018	57.051	57.084	57.118	57.151	57.184	57.217	1,800
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A6.1.2. *Type J thermocouples extended range—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F —Continued*

$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,800	56.886	56.919	56.952	56.985	57.018	57.051	57.084	57.118	57.151	57.184	57.217	1,800
1,810	57.217	57.250	57.283	57.316	57.349	57.382	57.415	57.448	57.481	57.514	57.547	1,810
1,820	57.547	57.580	57.613	57.646	57.679	57.712	57.745	57.778	57.810	57.843	57.876	1,820
1,830	57.876	57.909	57.942	57.975	58.008	58.041	58.074	58.106	58.139	58.172	58.205	1,830
1,840	58.205	58.238	58.271	58.303	58.336	58.369	58.402	58.435	58.467	58.500	58.533	1,840
1,850	58.533	58.566	58.598	58.631	58.664	58.697	58.729	58.762	58.795	58.827	58.860	1,850
1,860	58.860	58.893	58.926	58.958	58.991	59.024	59.056	59.089	59.121	59.154	59.187	1,860
1,870	59.187	59.219	59.252	59.285	59.317	59.350	59.382	59.415	59.448	59.480	59.513	1,870
1,880	59.513	59.545	59.578	59.610	59.643	59.676	59.708	59.741	59.773	59.806	59.838	1,880
1,890	59.838	59.871	59.903	59.936	59.968	60.001	60.033	60.066	60.098	60.131	60.163	1,890
1,900	60.163	60.196	60.228	60.261	60.293	60.326	60.358	60.390	60.423	60.455	60.488	1,900
1,910	60.488	60.520	60.553	60.585	60.617	60.650	60.682	60.715	60.747	60.779	60.812	1,910
1,920	60.812	60.844	60.876	60.909	60.941	60.974	61.006	61.038	61.071	61.103	61.135	1,920
1,930	61.135	61.168	61.200	61.232	61.265	61.297	61.329	61.362	61.394	61.426	61.459	1,930
1,940	61.459	61.491	61.523	61.555	61.588	61.620	61.652	61.685	61.717	61.749	61.781	1,940
1,950	61.781	61.814	61.846	61.878	61.910	61.943	61.975	62.007	62.039	62.072	62.104	1,950
1,960	62.104	62.136	62.168	62.201	62.233	62.265	62.297	62.330	62.362	62.394	62.426	1,960
1,970	62.426	62.458	62.491	62.523	62.555	62.587	62.619	62.652	62.684	62.716	62.748	1,970
1,980	62.748	62.780	62.813	62.845	62.877	62.909	62.941	62.974	63.006	63.038	63.070	1,980
1,990	63.070	63.102	63.134	63.167	63.199	63.231	63.263	63.295	63.327	63.359	63.392	1,990
2,000	63.392	63.424	63.456	63.488	63.520	63.552	63.584	63.617	63.649	63.681	63.713	2,000
2,010	63.713	63.745	63.777	63.809	63.842	63.874	63.906	63.938	63.970	64.002	64.034	2,010
2,020	64.034	64.066	64.098	64.131	64.163	64.195	64.227	64.259	64.291	64.323	64.355	2,020
2,030	64.355	64.387	64.420	64.452	64.484	64.516	64.548	64.580	64.612	64.644	64.676	2,030
2,040	64.676	64.708	64.740	64.773	64.805	64.837	64.869	64.901	64.933	64.965	64.997	2,040
2,050	64.997	65.029	65.061	65.093	65.125	65.158	65.190	65.222	65.254	65.286	65.318	2,050
2,060	65.318	65.350	65.382	65.414	65.446	65.478	65.510	65.542	65.574	65.606	65.638	2,060
2,070	65.638	65.671	65.703	65.735	65.767	65.799	65.831	65.863	65.895	65.927	65.959	2,070
2,080	65.959	65.991	66.023	66.055	66.087	66.119	66.151	66.183	66.215	66.247	66.279	2,080
2,090	66.279	66.311	66.343	66.375	66.407	66.439	66.472	66.504	66.536	66.568	66.600	2,090
2,100	66.600	66.632	66.664	66.696	66.728	66.760	66.792	66.824	66.856	66.888	66.920	2,100
2,110	66.920	66.952	66.984	67.016	67.048	67.080	67.112	67.144	67.176	67.208	67.240	2,110
2,120	67.240	67.272	67.304	67.336	67.368	67.400	67.432	67.464	67.495	67.527	67.559	2,120
2,130	67.559	67.591	67.623	67.655	67.687	67.719	67.751	67.783	67.815	67.847	67.879	2,130
2,140	67.879	67.911	67.943	67.975	68.007	68.039	68.071	68.103	68.134	68.166	68.198	2,140
2,150	68.198	68.230	68.262	68.294	68.326	68.358	68.390	68.422	68.454	68.486	68.517	2,150
2,160	68.517	68.549	68.581	68.613	68.645	68.677	68.709	68.741	68.772	68.804	68.836	2,160
2,170	68.836	68.868	68.900	68.932	68.964	68.995	69.027	69.059	69.091	69.123	69.155	2,170
2,180	69.155	69.186	69.218	69.250	69.282	69.314	69.345	69.377	69.409	69.441	69.472	2,180
2,190	69.472	69.504	69.536									2,190
$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$

TABLE A6.1.3. *Type J thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature ($^{\circ}\text{C}$) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius*

Temperature Range (C°)	a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (μV)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
-200 to 0	.....	..	5, 0408743	+1	3, 2009063	-2	-6, 3493968	-5	2, 5174022	-7	-.2 to .3
-200 to 760	.....	..	4, 9502533	+1	3, 2898022	-2	-6, 9936031	-5	5, 1112729	-8	-100 to 80
-200 to 1200	.....	..	4, 7062907	+1	2, 5522650	-2	-2, 2198295	-5	7, 1373907	-9	-500 to 600
- 20 to 500	.....	..	5, 0465304	+1	2, 8062596	-2	-6, 5666305	-5	5, 3587106	-8	-1.5 to 3, 0
0 to 400	.....	..	5, 0452399	+1	2, 8409137	-2	-6, 7556436	-5	5, 6382040	-8	-.8 to .5
0 to 760	.....	..	5, 1258213	+1	2, 0040854	-2	-4, 2235982	-5	3, 2819408	-8	-24 to 36
0 to 1200	.....	..	5, 5861877	+1	-1, 4207954	-2	3, 1325181	-5	-1, 5023710	-8	-210 to 160
400 to 760	-5, 7931005	+3	9, 7718575	+1	-1, 1658430	-1	1, 3184454	-4	-4, 8218788	-8	-2.5 to 2.8
400 to 1200	7, 1127371	+3	1, 8969007	+1	5, 3862730	-2	-2, 2171472	-5	1, 8445398	-10	-110 to 100
600 to 760	-2, 5724435	+4	2, 2157898	+2	-4, 0418097	-1	4, 2749984	-4	1, 6174242	-7	-.1 to .1
760 to 1200	3, 9064962	+4	-1, 4765017	+2	3, 6470921	-1	-2, 7029005	-4	7, 2113090	-8	-11 to 11
II. Cubic Equation											
-200 to 0	.....	..	5, 0010246	+1	2, 0437543	-2	-1, 6133895	-4	.....	..	-4 to 4
-200 to 760	.....	..	4, 7253475	+1	2, 5046705	-2	-1, 7846422	-5	.....	..	-500 to 500
-200 to 1200	.....	..	4, 7167178	+1	1, 9446043	-2	-8, 7617925	-6	.....	..	-400 to 700
- 20 to 500	.....	..	5, 1724839	+1	1, 3054732	-2	-1, 4132471	-5	.....	..	-35 to 35
0 to 400	.....	..	5, 1181777	+1	1, 7947441	-2	-2, 3602579	-5	.....	..	-17 to 13
0 to 760	.....	..	5, 4105233	+1	-1, 7123662	-3	6, 1865084	-6	.....	..	-130 to 100
0 to 1200	.....	..	5, 0799191	+1	1, 0477066	-2	-3, 6454477	-6	.....	..	-400 to 350
400 to 760	-8, 5364630	+2	6, 1895270	+1	-2, 0833283	-2	1, 9993203	-5	.....	..	-8 to 8
400 to 1200	7, 0555693	+3	1, 9299007	+1	5, 3184827	-2	-2, 1581517	-5	.....	..	-110 to 100
600 to 760	8, 4045186	+3	1, 9457813	+1	4, 3662315	-2	-1, 2504038	-5	.....	..	-.9 to .9
760 to 1200	-2, 3995777	+4	1, 1660547	+2	-4, 6945343	-2	1, 2266074	-5	.....	..	-2.6 to 2.8
Variable reference junction correction											
0 to 50	.....	..	5, 0373743	+1	3, 0167011	-2	-7, 4293513	-5	.....	..	-0.06 to +0.06
III. Quadratic Equation											
-200 to 0	.....	..	5, 2861807	+1	6, 5722566	-2	.....	..	.....	..	-50 to 55
-200 to 760	.....	..	4, 8944663	+1	1, 0510184	-2	.....	..	.....	..	-400 to 1500
-200 to 1200	.....	..	5, 1514166	+1	5, 9801120	-3	.....	..	.....	..	-900 to 2200
- 20 to 500	.....	..	5, 3257575	+1	3, 2259487	-3	.....	..	.....	..	-100 to 70
0 to 400	.....	..	5, 2818359	+1	4, 8483890	-3	.....	..	.....	..	-70 to 50
0 to 760	.....	..	5, 2559110	+1	4, 8102627	-3	.....	..	.....	..	-170 to 200
0 to 1200	.....	..	5, 3051142	+1	4, 4372939	-3	.....	..	.....	..	-550 to 550
400 to 760	2, 7854419	+3	4, 2164097	+1	1, 3964245	-2	.....	..	.....	..	-40 to 30
400 to 1200	-2, 0825292	+3	5, 8357175	+1	1, 3743151	-3	.....	..	.....	..	-400 to 400
600 to 760	4, 5178106	+3	3, 6728317	+1	1, 8167261	-2	.....	..	.....	..	-2.7 to 2.1
760 to 1200	-1, 2848080	+4	8, 1661200	+1	-1, 0874407	-2	.....	..	.....	..	-45 to 50
Variable reference junction correction											
0 to 50	.....	..	5, 0462105	+1	2, 4476444	-2	.....	..	.....	..	-0.4 to +0.8

A6.2. Data for Temperature as a Function of Voltage

The temperature as a function of voltage data given in tables A6.2.1 and A6.2.2 were obtained by iteration in the primary equations for voltage as a function of temperature. Table A6.2.1 presents the data in millivolts from -8.09 mV to 69.53 mV with temperatures given in degrees Celsius while table A6.2.2 presents similar data with temperatures in degrees Fahrenheit. As discussed in section 6.2 of the text, the values given for Type J thermocouples above 760°C (1400°F) are not suitable for precise temperature measurements. Table A6.2.3 contains quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges. The error range given in the table represents the difference between the temperature found by iteration in the full precision tables from the text and from the respective reduced order approximations.

TABLE A6.2.1. *Type J thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (1PTS 1968)												
-8.00	-205.17	-205.66	-206.16	-206.65	-207.15	-207.66	-208.16	-208.67	-209.19	-209.71		-8.00
-7.90	-200.44	-200.90	-201.36	-201.83	-202.30	-202.77	-203.24	-203.72	-204.20	-204.69	-205.17	-7.90
-7.80	-195.96	-196.40	-196.84	-197.28	-197.72	-198.17	-198.62	-199.07	-199.52	-199.98	-200.44	-7.80
-7.70	-191.70	-192.12	-192.54	-192.96	-193.38	-193.81	-194.23	-194.66	-195.09	-195.53	-195.96	-7.70
-7.60	-187.62	-188.03	-188.43	-188.83	-189.24	-189.64	-190.05	-190.46	-190.87	-191.29	-191.70	-7.60
-7.50	-183.70	-184.09	-184.48	-184.86	-185.25	-185.65	-186.04	-186.43	-186.83	-187.23	-187.62	-7.50
-7.40	-179.92	-180.29	-180.67	-181.04	-181.42	-181.80	-182.17	-182.55	-182.94	-183.32	-183.70	-7.40
-7.30	-176.25	-176.61	-176.98	-177.34	-177.71	-178.07	-178.44	-178.81	-179.18	-179.55	-179.92	-7.30
-7.20	-172.69	-173.05	-173.40	-173.75	-174.11	-174.46	-174.82	-175.17	-175.53	-175.89	-176.25	-7.20
-7.10	-169.23	-169.57	-169.92	-170.26	-170.61	-170.95	-171.30	-171.65	-171.99	-172.34	-172.69	-7.10
-7.00	-165.85	-166.19	-166.52	-166.86	-167.19	-167.53	-167.87	-168.21	-168.55	-168.89	-169.23	-7.00
-6.90	-162.56	-162.88	-163.21	-163.54	-163.87	-164.20	-164.53	-164.86	-165.19	-165.52	-165.85	-6.90
-6.80	-159.33	-159.65	-159.97	-160.29	-160.61	-160.93	-161.26	-161.58	-161.90	-162.23	-162.56	-6.80
-6.70	-156.17	-156.48	-156.79	-157.11	-157.42	-157.74	-158.06	-158.37	-158.69	-159.01	-159.33	-6.70
-6.60	-153.07	-153.37	-153.68	-153.99	-154.30	-154.61	-154.92	-155.23	-155.54	-155.85	-156.17	-6.60
-6.50	-150.02	-150.32	-150.63	-150.93	-151.23	-151.54	-151.84	-152.15	-152.45	-152.76	-153.07	-6.50
-6.40	-147.03	-147.32	-147.62	-147.92	-148.22	-148.52	-148.82	-149.12	-149.42	-149.72	-150.02	-6.40
-6.30	-144.08	-144.37	-144.67	-144.96	-145.25	-145.55	-145.84	-146.14	-146.43	-146.73	-147.03	-6.30
-6.20	-141.18	-141.47	-141.76	-142.05	-142.34	-142.63	-142.92	-143.21	-143.50	-143.79	-144.08	-6.20
-6.10	-138.33	-138.61	-138.89	-139.18	-139.46	-139.75	-140.04	-140.32	-140.61	-140.90	-141.18	-6.10
-6.00	-135.51	-135.79	-136.07	-136.35	-136.63	-136.91	-137.19	-137.48	-137.76	-138.04	-138.33	-6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. *Type J thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
-6.00	-135.51	-135.79	-136.07	-136.35	-136.63	-136.91	-137.19	-137.48	-137.76	-138.04	-138.33	-6.00
-5.90	-132.73	-133.00	-133.28	-133.56	-133.84	-134.11	-134.39	-134.67	-134.95	-135.23	-135.51	-5.90
-5.80	-129.98	-130.26	-130.53	-130.80	-131.08	-131.35	-131.63	-131.90	-132.18	-132.45	-132.73	-5.80
-5.70	-127.27	-127.54	-127.81	-128.08	-128.35	-128.62	-128.89	-129.17	-129.44	-129.71	-129.98	-5.70
-5.60	-124.59	-124.86	-125.13	-125.39	-125.66	-125.93	-126.20	-126.46	-126.73	-127.00	-127.27	-5.60
-5.50	-121.94	-122.21	-122.47	-122.73	-123.00	-123.26	-123.53	-123.79	-124.06	-124.33	-124.59	-5.50
-5.40	-119.32	-119.58	-119.84	-120.10	-120.37	-120.63	-120.89	-121.15	-121.42	-121.68	-121.94	-5.40
-5.30	-116.73	-116.98	-117.24	-117.50	-117.76	-118.02	-118.28	-118.54	-118.80	-119.06	-119.32	-5.30
-5.20	-114.16	-114.41	-114.67	-114.92	-115.18	-115.44	-115.69	-115.95	-116.21	-116.47	-116.73	-5.20
-5.10	-111.61	-111.87	-112.12	-112.37	-112.63	-112.88	-113.14	-113.39	-113.65	-113.90	-114.16	-5.10
-5.00	-109.09	-109.34	-109.59	-109.84	-110.10	-110.35	-110.60	-110.85	-111.11	-111.36	-111.61	-5.00
-4.90	-106.59	-106.84	-107.09	-107.34	-107.59	-107.84	-108.09	-108.34	-108.59	-108.84	-109.09	-4.90
-4.80	-104.11	-104.36	-104.61	-104.86	-105.10	-105.35	-105.60	-105.85	-106.09	-106.34	-106.59	-4.80
-4.70	-101.66	-101.90	-102.15	-102.39	-102.64	-102.88	-103.13	-103.37	-103.62	-103.87	-104.11	-4.70
-4.60	-99.22	-99.46	-99.71	-99.95	-100.19	-100.44	-100.68	-100.92	-101.17	-101.41	-101.66	-4.60
-4.50	-96.80	-97.04	-97.28	-97.52	-97.77	-98.01	-98.25	-98.49	-98.73	-98.98	-99.22	-4.50
-4.40	-94.40	-94.64	-94.88	-95.12	-95.36	-95.60	-95.84	-96.08	-96.32	-96.56	-96.80	-4.40
-4.30	-92.02	-92.26	-92.49	-92.73	-92.97	-93.21	-93.45	-93.68	-93.92	-94.16	-94.40	-4.30
-4.20	-89.65	-89.89	-90.12	-90.36	-90.60	-90.83	-91.07	-91.31	-91.54	-91.78	-92.02	-4.20
-4.10	-87.30	-87.54	-87.77	-88.00	-88.24	-88.47	-88.71	-88.94	-89.18	-89.42	-89.65	-4.10
-4.00	-84.97	-85.20	-85.43	-85.67	-85.90	-86.13	-86.37	-86.60	-86.83	-87.07	-87.30	-4.00
-3.90	-82.65	-82.88	-83.11	-83.34	-83.57	-83.80	-84.04	-84.27	-84.50	-84.73	-84.97	-3.90
-3.80	-80.34	-80.57	-80.80	-81.03	-81.26	-81.49	-81.72	-81.95	-82.18	-82.42	-82.65	-3.80
-3.70	-78.05	-78.28	-78.51	-78.74	-78.96	-79.19	-79.42	-79.65	-79.88	-80.11	-80.34	-3.70
-3.60	-75.77	-76.00	-76.23	-76.45	-76.68	-76.91	-77.14	-77.36	-77.59	-77.82	-78.05	-3.60
-3.50	-73.51	-73.73	-73.96	-74.18	-74.41	-74.64	-74.86	-75.09	-75.32	-75.54	-75.77	-3.50
-3.40	-71.25	-71.48	-71.70	-71.93	-72.15	-72.38	-72.60	-72.83	-73.05	-73.28	-73.51	-3.40
-3.30	-69.01	-69.24	-69.46	-69.68	-69.91	-70.13	-70.36	-70.58	-70.80	-71.03	-71.25	-3.30
-3.20	-66.78	-67.01	-67.23	-67.45	-67.67	-67.90	-68.12	-68.34	-68.57	-68.79	-69.01	-3.20
-3.10	-64.57	-64.79	-65.01	-65.23	-65.45	-65.67	-65.90	-66.12	-66.34	-66.56	-66.78	-3.10
-3.00	-62.36	-62.58	-62.80	-63.02	-63.24	-63.46	-63.68	-63.90	-64.13	-64.35	-64.57	-3.00
-2.90	-60.17	-60.38	-60.60	-60.82	-61.04	-61.26	-61.48	-61.70	-61.92	-62.14	-62.36	-2.90
-2.80	-57.98	-58.20	-58.42	-58.63	-58.85	-59.07	-59.29	-59.51	-59.73	-59.95	-60.17	-2.80
-2.70	-55.80	-56.02	-56.24	-56.46	-56.67	-56.89	-57.11	-57.33	-57.54	-57.76	-57.98	-2.70
-2.60	-53.64	-53.86	-54.07	-54.29	-54.50	-54.72	-54.94	-55.15	-55.37	-55.59	-55.80	-2.60
-2.50	-51.48	-51.70	-51.91	-52.13	-52.34	-52.56	-52.78	-52.99	-53.21	-53.42	-53.64	-2.50
-2.40	-49.34	-49.55	-49.76	-49.98	-50.19	-50.41	-50.62	-50.84	-51.05	-51.27	-51.48	-2.40
-2.30	-47.20	-47.41	-47.62	-47.84	-48.05	-48.27	-48.48	-48.69	-48.91	-49.12	-49.34	-2.30
-2.20	-45.07	-45.28	-45.49	-45.71	-45.92	-46.13	-46.35	-46.56	-46.77	-46.98	-47.20	-2.20
-2.10	-42.95	-43.16	-43.37	-43.58	-43.79	-44.01	-44.22	-44.43	-44.64	-44.86	-45.07	-2.10
-2.00	-40.83	-41.05	-41.26	-41.47	-41.68	-41.89	-42.10	-42.31	-42.52	-42.74	-42.95	-2.00
-1.90	-38.73	-38.94	-39.15	-39.36	-39.57	-39.78	-39.99	-40.20	-40.41	-40.62	-40.83	-1.90
-1.80	-36.63	-36.84	-37.05	-37.26	-37.47	-37.68	-37.89	-38.10	-38.31	-38.52	-38.73	-1.80
-1.70	-34.54	-34.75	-34.96	-35.17	-35.38	-35.59	-35.80	-36.01	-36.21	-36.42	-36.63	-1.70
-1.60	-32.46	-32.67	-32.88	-33.08	-33.29	-33.50	-33.71	-33.92	-34.13	-34.33	-34.54	-1.60
-1.50	-30.39	-30.59	-30.80	-31.01	-31.21	-31.42	-31.63	-31.84	-32.05	-32.25	-32.46	-1.50
-1.40	-28.32	-28.52	-28.73	-28.94	-29.14	-29.35	-29.56	-29.76	-29.97	-30.18	-30.39	-1.40
-1.30	-26.26	-26.46	-26.67	-26.87	-27.08	-27.29	-27.49	-27.70	-27.90	-28.11	-28.32	-1.30
-1.20	-24.20	-24.41	-24.61	-24.82	-25.02	-25.23	-25.43	-25.64	-25.84	-26.05	-26.26	-1.20
-1.10	-22.15	-22.36	-22.56	-22.77	-22.97	-23.18	-23.38	-23.59	-23.79	-24.00	-24.20	-1.10
-1.00	-20.11	-20.31	-20.52	-20.72	-20.93	-21.13	-21.34	-21.54	-21.74	-21.95	-22.15	-1.00
-0.90	-18.07	-18.28	-18.48	-18.68	-18.89	-19.09	-19.30	-19.50	-19.70	-19.91	-20.11	-0.90
-0.80	-16.04	-16.25	-16.45	-16.65	-16.86	-17.06	-17.26	-17.46	-17.67	-17.87	-18.07	-0.80
-0.70	-14.02	-14.22	-14.42	-14.63	-14.83	-15.03	-15.23	-15.44	-15.64	-15.84	-16.04	-0.70
-0.60	-12.00	-12.20	-12.40	-12.61	-12.81	-13.01	-13.21	-13.41	-13.62	-13.82	-14.02	-0.60
-0.50	-9.99	-10.19	-10.39	-10.59	-10.79	-10.99	-11.20	-11.40	-11.60	-11.80	-12.00	-0.50
-0.40	-7.98	-8.18	-8.38	-8.58	-8.78	-8.98	-9.18	-9.39	-9.59	-9.79	-9.99	-0.40
-0.30	-5.98	-6.18	-6.38	-6.58	-6.78	-6.98	-7.18	-7.38	-7.58	-7.78	-7.98	-0.30
-0.20	-3.98	-4.18	-4.38	-4.58	-4.78	-4.98	-5.18	-5.38	-5.58	-5.78	-5.98	-0.20
-0.10	-1.99	-2.19	-2.39	-2.58	-2.78	-2.98	-3.18	-3.38	-3.58	-3.78	-3.98	-0.10
-0.00	0.00	-0.20	-0.40	-0.60	-0.79	-0.99	-1.19	-1.39	-1.59	-1.79	-1.99	-0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. *Type J thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
0.00	0.00	0.20	0.40	0.60	0.79	0.99	1.19	1.39	1.59	1.78	1.98	0.00
0.10	1.98	2.18	2.38	2.58	2.77	2.97	3.17	3.37	3.57	3.76	3.96	0.10
0.20	3.96	4.16	4.36	4.55	4.75	4.95	5.15	5.34	5.54	5.74	5.93	0.20
0.30	5.93	6.13	6.33	6.53	6.72	6.92	7.12	7.31	7.51	7.71	7.90	0.30
0.40	7.90	8.10	8.30	8.49	8.69	8.89	9.08	9.28	9.48	9.67	9.87	0.40
0.50	9.87	10.07	10.26	10.46	10.65	10.85	11.05	11.24	11.44	11.63	11.83	0.50
0.60	11.83	12.03	12.22	12.42	12.61	12.81	13.00	13.20	13.39	13.59	13.79	0.60
0.70	13.79	13.98	14.18	14.37	14.57	14.76	14.96	15.15	15.35	15.54	15.74	0.70
0.80	15.74	15.93	16.13	16.32	16.52	16.71	16.91	17.10	17.30	17.49	17.69	0.80
0.90	17.69	17.88	18.08	18.27	18.47	18.66	18.85	19.05	19.24	19.44	19.63	0.90
1.00	19.63	19.83	20.02	20.21	20.41	20.60	20.80	20.99	21.18	21.38	21.57	1.00
1.10	21.57	21.77	21.96	22.15	22.35	22.54	22.74	22.93	23.12	23.32	23.51	1.10
1.20	23.51	23.70	23.90	24.09	24.28	24.48	24.67	24.86	25.06	25.25	25.44	1.20
1.30	25.44	25.64	25.83	26.02	26.22	26.41	26.60	26.79	26.99	27.18	27.37	1.30
1.40	27.37	27.57	27.76	27.95	28.14	28.34	28.53	28.72	28.92	29.11	29.30	1.40
1.50	29.30	29.49	29.69	29.88	30.07	30.26	30.45	30.65	30.84	31.03	31.22	1.50
1.60	31.22	31.42	31.61	31.80	31.99	32.18	32.38	32.57	32.76	32.95	33.14	1.60
1.70	33.14	33.34	33.53	33.72	33.91	34.10	34.29	34.49	34.68	34.87	35.06	1.70
1.80	35.06	35.25	35.44	35.64	35.83	36.02	36.21	36.40	36.59	36.78	36.97	1.80
1.90	36.97	37.17	37.36	37.55	37.74	37.93	38.12	38.31	38.50	38.69	38.88	1.90
2.00	38.88	39.08	39.27	39.46	39.65	39.84	40.03	40.22	40.41	40.60	40.79	2.00
2.10	40.79	40.98	41.17	41.36	41.55	41.75	41.94	42.13	42.32	42.51	42.70	2.10
2.20	42.70	42.89	43.08	43.27	43.46	43.65	43.84	44.03	44.22	44.41	44.60	2.20
2.30	44.60	44.79	44.98	45.17	45.36	45.55	45.74	45.93	46.12	46.31	46.50	2.30
2.40	46.50	46.69	46.88	47.07	47.26	47.45	47.64	47.83	48.02	48.20	48.39	2.40
2.50	48.39	48.58	48.77	48.96	49.15	49.34	49.53	49.72	49.91	50.10	50.29	2.50
2.60	50.29	50.48	50.67	50.86	51.04	51.23	51.42	51.61	51.80	51.99	52.18	2.60
2.70	52.18	52.37	52.56	52.75	52.93	53.12	53.31	53.50	53.69	53.88	54.07	2.70
2.80	54.07	54.26	54.44	54.63	54.82	55.01	55.20	55.39	55.58	55.76	55.95	2.80
2.90	55.95	56.14	56.33	56.52	56.71	56.90	57.08	57.27	57.46	57.65	57.84	2.90
3.00	57.84	58.03	58.21	58.40	58.59	58.78	58.97	59.15	59.34	59.53	59.72	3.00
3.10	59.72	59.91	60.09	60.28	60.47	60.66	60.85	61.03	61.22	61.41	61.60	3.10
3.20	61.60	61.78	61.97	62.16	62.35	62.54	62.72	62.91	63.10	63.29	63.47	3.20
3.30	63.47	63.66	63.85	64.04	64.22	64.41	64.60	64.79	64.97	65.16	65.35	3.30
3.40	65.35	65.53	65.72	65.91	66.10	66.28	66.47	66.66	66.85	67.03	67.22	3.40
3.50	67.22	67.41	67.59	67.78	67.97	68.15	68.34	68.53	68.72	68.90	69.09	3.50
3.60	69.09	69.28	69.46	69.65	69.84	70.02	70.21	70.40	70.58	70.77	70.96	3.60
3.70	70.96	71.14	71.33	71.52	71.70	71.89	72.08	72.26	72.45	72.64	72.82	3.70
3.80	72.82	73.01	73.20	73.38	73.57	73.76	73.94	74.13	74.31	74.50	74.69	3.80
3.90	74.69	74.87	75.06	75.25	75.43	75.62	75.80	75.99	76.18	76.36	76.55	3.90
4.00	76.55	76.73	76.92	77.11	77.29	77.48	77.66	77.85	78.04	78.22	78.41	4.00
4.10	78.41	78.59	78.78	78.97	79.15	79.34	79.52	79.71	79.90	80.08	80.27	4.10
4.20	80.27	80.45	80.64	80.82	81.01	81.20	81.38	81.57	81.75	81.94	82.12	4.20
4.30	82.12	82.31	82.49	82.68	82.86	83.05	83.24	83.42	83.61	83.79	83.98	4.30
4.40	83.98	84.16	84.35	84.53	84.72	84.90	85.09	85.27	85.46	85.65	85.83	4.40
4.50	85.83	86.02	86.20	86.39	86.57	86.76	86.94	87.13	87.31	87.50	87.68	4.50
4.60	87.68	87.87	88.05	88.24	88.42	88.61	88.79	88.98	89.16	89.35	89.53	4.60
4.70	89.53	89.72	89.90	90.09	90.27	90.45	90.64	90.82	91.01	91.19	91.38	4.70
4.80	91.38	91.56	91.75	91.93	92.12	92.30	92.49	92.67	92.86	93.04	93.22	4.80
4.90	93.22	93.41	93.59	93.78	93.96	94.15	94.33	94.52	94.70	94.88	95.07	4.90
5.00	95.07	95.25	95.44	95.62	95.81	95.99	96.18	96.36	96.54	96.73	96.91	5.00
5.10	96.91	97.10	97.28	97.47	97.65	97.83	98.02	98.20	98.39	98.57	98.75	5.10
5.20	98.75	98.94	99.12	99.31	99.49	99.67	99.86	100.04	100.23	100.41	100.59	5.20
5.30	100.59	100.78	100.96	101.15	101.33	101.51	101.70	101.88	102.07	102.25	102.43	5.30
5.40	102.43	102.62	102.80	102.98	103.17	103.35	103.54	103.72	103.90	104.09	104.27	5.40
5.50	104.27	104.45	104.64	104.82	105.01	105.19	105.37	105.56	105.74	105.92	106.11	5.50
5.60	106.11	106.29	106.47	106.66	106.84	107.02	107.21	107.39	107.57	107.76	107.94	5.60
5.70	107.94	108.13	108.31	108.49	108.68	108.86	109.04	109.23	109.41	109.59	109.78	5.70
5.80	109.78	109.96	110.14	110.33	110.51	110.69	110.87	111.06	111.24	111.42	111.61	5.80
5.90	111.61	111.79	111.97	112.16	112.34	112.52	112.71	112.89	113.07	113.26	113.44	5.90
6.00	113.44	113.62	113.81	113.99	114.17	114.35	114.54	114.72	114.90	115.09	115.27	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. Type J thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
6.00	113.44	113.62	113.81	113.99	114.17	114.35	114.54	114.72	114.90	115.09	115.27	6.00
6.10	115.27	115.45	115.63	115.82	116.00	116.18	116.37	116.55	116.73	116.92	117.10	6.10
6.20	117.10	117.28	117.46	117.65	117.83	118.01	118.19	118.38	118.56	118.74	118.93	6.20
6.30	118.93	119.11	119.29	119.47	119.66	119.84	120.02	120.20	120.39	120.57	120.75	6.30
6.40	120.75	120.93	121.12	121.30	121.48	121.67	121.85	122.03	122.21	122.40	122.58	6.40
6.50	122.58	122.76	122.94	123.13	123.31	123.49	123.67	123.86	124.04	124.22	124.40	6.50
6.60	124.40	124.58	124.77	124.95	125.13	125.31	125.50	125.68	125.86	126.04	126.23	6.60
6.70	126.23	126.41	126.59	126.77	126.96	127.14	127.32	127.50	127.68	127.87	128.05	6.70
6.80	128.05	128.23	128.41	128.60	128.78	128.96	129.14	129.32	129.51	129.69	129.87	6.80
6.90	129.87	130.05	130.23	130.42	130.60	130.78	130.96	131.15	131.33	131.51	131.69	6.90
7.00	131.69	131.87	132.06	132.24	132.42	132.60	132.78	132.97	133.15	133.33	133.51	7.00
7.10	133.51	133.69	133.87	134.06	134.24	134.42	134.60	134.78	134.97	135.15	135.33	7.10
7.20	135.33	135.51	135.69	135.88	136.06	136.24	136.42	136.60	136.78	136.97	137.15	7.20
7.30	137.15	137.33	137.51	137.69	137.88	138.06	138.24	138.42	138.60	138.78	138.97	7.30
7.40	138.97	139.15	139.33	139.51	139.69	139.87	140.06	140.24	140.42	140.60	140.78	7.40
7.50	140.78	140.96	141.15	141.33	141.51	141.69	141.87	142.05	142.23	142.42	142.60	7.50
7.60	142.60	142.78	142.96	143.14	143.32	143.51	143.69	143.87	144.05	144.23	144.41	7.60
7.70	144.41	144.59	144.78	144.96	145.14	145.32	145.50	145.68	145.86	146.05	146.23	7.70
7.80	146.23	146.41	146.59	146.77	146.95	147.13	147.32	147.50	147.68	147.86	148.04	7.80
7.90	148.04	148.22	148.40	148.59	148.77	148.95	149.13	149.31	149.49	149.67	149.85	7.90
8.00	149.85	150.04	150.22	150.40	150.58	150.76	150.94	151.12	151.30	151.49	151.67	8.00
8.10	151.67	151.85	152.03	152.21	152.39	152.57	152.75	152.93	153.12	153.30	153.48	8.10
8.20	153.48	153.66	153.84	154.02	154.20	154.38	154.56	154.75	154.93	155.11	155.29	8.20
8.30	155.29	155.47	155.65	155.83	156.01	156.19	156.38	156.56	156.74	156.92	157.10	8.30
8.40	157.10	157.28	157.46	157.64	157.82	158.00	158.19	158.37	158.55	158.73	158.91	8.40
8.50	158.91	159.09	159.27	159.45	159.63	159.81	160.00	160.18	160.36	160.54	160.72	8.50
8.60	160.72	160.90	161.08	161.26	161.44	161.62	161.80	161.99	162.17	162.35	162.53	8.60
8.70	162.53	162.71	162.89	163.07	163.25	163.43	163.61	163.79	163.97	164.16	164.34	8.70
8.80	164.34	164.52	164.70	164.88	165.06	165.24	165.42	165.60	165.78	165.96	166.14	8.80
8.90	166.14	166.32	166.51	166.69	166.87	167.05	167.23	167.41	167.59	167.77	167.95	8.90
9.00	167.95	168.13	168.31	168.49	168.67	168.85	169.04	169.22	169.40	169.58	169.76	9.00
9.10	169.76	169.94	170.12	170.30	170.48	170.66	170.84	171.02	171.20	171.38	171.56	9.10
9.20	171.56	171.75	171.93	172.11	172.29	172.47	172.65	172.83	173.01	173.19	173.37	9.20
9.30	173.37	173.55	173.73	173.91	174.09	174.27	174.45	174.63	174.82	175.00	175.18	9.30
9.40	175.18	175.36	175.54	175.72	175.90	176.08	176.26	176.44	176.62	176.80	176.98	9.40
9.50	176.98	177.16	177.34	177.52	177.70	177.88	178.06	178.25	178.43	178.61	178.79	9.50
9.60	178.79	178.97	179.15	179.33	179.51	179.69	179.87	180.05	180.23	180.41	180.59	9.60
9.70	180.59	180.77	180.95	181.13	181.31	181.49	181.67	181.85	182.03	182.22	182.40	9.70
9.80	182.40	182.58	182.76	182.94	183.12	183.30	183.48	183.66	183.84	184.02	184.20	9.80
9.90	184.20	184.38	184.56	184.74	184.92	185.10	185.28	185.46	185.64	185.82	186.00	9.90
10.00	186.00	186.18	186.36	186.54	186.72	186.90	187.09	187.27	187.45	187.63	187.81	10.00
10.10	187.81	187.99	188.17	188.35	188.53	188.71	188.89	189.07	189.25	189.43	189.61	10.10
10.20	189.61	189.79	189.97	190.15	190.33	190.51	190.69	190.87	191.05	191.23	191.41	10.20
10.30	191.41	191.59	191.77	191.95	192.13	192.31	192.49	192.67	192.85	193.03	193.21	10.30
10.40	193.21	193.40	193.58	193.76	193.94	194.12	194.30	194.48	194.66	194.84	195.02	10.40
10.50	195.02	195.20	195.38	195.56	195.74	195.92	196.10	196.28	196.46	196.64	196.82	10.50
10.60	196.82	197.00	197.18	197.36	197.54	197.72	197.90	198.08	198.26	198.44	198.62	10.60
10.70	198.62	198.80	198.98	199.16	199.34	199.52	199.70	199.88	200.06	200.24	200.42	10.70
10.80	200.42	200.60	200.78	200.96	201.14	201.32	201.50	201.68	201.86	202.04	202.22	10.80
10.90	202.22	202.40	202.59	202.77	202.95	203.13	203.31	203.49	203.67	203.85	204.03	10.90
11.00	204.03	204.21	204.39	204.57	204.75	204.93	205.11	205.29	205.47	205.65	205.83	11.00
11.10	205.83	206.01	206.19	206.37	206.55	206.73	206.91	207.09	207.27	207.45	207.63	11.10
11.20	207.63	207.81	207.99	208.17	208.35	208.53	208.71	208.89	209.07	209.25	209.43	11.20
11.30	209.43	209.61	209.79	209.97	210.15	210.33	210.51	210.69	210.87	211.05	211.23	11.30
11.40	211.23	211.41	211.59	211.77	211.95	212.13	212.31	212.49	212.67	212.85	213.03	11.40
11.50	213.03	213.21	213.39	213.57	213.75	213.93	214.11	214.29	214.47	214.65	214.83	11.50
11.60	214.83	215.01	215.19	215.37	215.55	215.73	215.91	216.09	216.27	216.45	216.63	11.60
11.70	216.63	216.81	216.99	217.17	217.35	217.53	217.71	217.89	218.07	218.25	218.43	11.70
11.80	218.43	218.61	218.79	218.97	219.15	219.33	219.51	219.69	219.87	220.05	220.23	11.80
11.90	220.23	220.41	220.59	220.77	220.95	221.13	221.31	221.49	221.68	221.86	222.04	11.90
12.00	222.04	222.22	222.40	222.58	222.76	222.94	223.12	223.30	223.48	223.66	223.84	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. *Type J thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
12.00	222.04	222.22	222.40	222.58	222.76	222.94	223.12	223.30	223.48	223.66	223.84	12.00
12.10	223.84	224.02	224.20	224.38	224.56	224.74	224.92	225.10	225.28	225.46	225.64	12.10
12.20	225.64	225.82	226.00	226.18	226.36	226.54	226.72	226.90	227.08	227.26	227.44	12.20
12.30	227.44	227.62	227.80	227.98	228.16	228.34	228.52	228.70	228.88	229.06	229.24	12.30
12.40	229.24	229.42	229.60	229.78	229.96	230.14	230.32	230.50	230.68	230.86	231.04	12.40
12.50	231.04	231.22	231.40	231.58	231.76	231.94	232.12	232.30	232.48	232.66	232.84	12.50
12.60	232.84	233.02	233.20	233.38	233.56	233.74	233.92	234.10	234.28	234.46	234.64	12.60
12.70	234.64	234.82	235.00	235.18	235.36	235.54	235.72	235.90	236.08	236.26	236.44	12.70
12.80	236.44	236.62	236.80	236.98	237.16	237.34	237.52	237.70	237.88	238.06	238.24	12.80
12.90	238.24	238.42	238.60	238.78	238.96	239.14	239.32	239.50	239.68	239.86	240.04	12.90
13.00	240.04	240.22	240.40	240.58	240.76	240.94	241.12	241.30	241.48	241.66	241.84	13.00
13.10	241.84	242.02	242.20	242.38	242.56	242.74	242.92	243.10	243.28	243.46	243.64	13.10
13.20	243.64	243.82	244.00	244.18	244.36	244.54	244.72	244.90	245.08	245.26	245.44	13.20
13.30	245.44	245.62	245.80	245.98	246.16	246.34	246.52	246.71	246.89	247.07	247.25	13.30
13.40	247.25	247.43	247.61	247.79	247.97	248.15	248.33	248.51	248.69	248.87	249.05	13.40
13.50	249.05	249.23	249.41	249.59	249.77	249.95	250.13	250.31	250.49	250.67	250.85	13.50
13.60	250.85	251.03	251.21	251.39	251.57	251.75	251.93	252.11	252.29	252.47	252.65	13.60
13.70	252.65	252.83	253.01	253.19	253.37	253.55	253.73	253.91	254.09	254.27	254.45	13.70
13.80	254.45	254.63	254.81	254.99	255.17	255.35	255.53	255.71	255.89	256.07	256.25	13.80
13.90	256.25	256.43	256.61	256.79	256.97	257.15	257.33	257.51	257.69	257.87	258.05	13.90
14.00	258.05	258.24	258.42	258.60	258.78	258.96	259.14	259.32	259.50	259.68	259.86	14.00
14.10	259.86	260.04	260.22	260.40	260.58	260.76	260.94	261.12	261.30	261.48	261.66	14.10
14.20	261.66	261.84	262.02	262.20	262.38	262.56	262.74	262.92	263.10	263.28	263.46	14.20
14.30	263.46	263.64	263.82	264.00	264.18	264.36	264.54	264.72	264.90	265.08	265.26	14.30
14.40	265.26	265.44	265.62	265.80	265.98	266.17	266.35	266.53	266.71	266.89	267.07	14.40
14.50	267.07	267.25	267.43	267.61	267.79	267.97	268.15	268.33	268.51	268.69	268.87	14.50
14.60	268.87	269.05	269.23	269.41	269.59	269.77	269.95	270.13	270.31	270.49	270.67	14.60
14.70	270.67	270.85	271.03	271.21	271.39	271.57	271.75	271.93	272.11	272.29	272.48	14.70
14.80	272.48	272.66	272.84	273.02	273.20	273.38	273.56	273.74	273.92	274.10	274.28	14.80
14.90	274.28	274.46	274.64	274.82	275.00	275.18	275.36	275.54	275.72	275.90	276.08	14.90
15.00	276.08	276.26	276.44	276.62	276.80	276.98	277.16	277.34	277.53	277.71	277.89	15.00
15.10	277.89	278.07	278.25	278.43	278.61	278.79	278.97	279.15	279.33	279.51	279.69	15.10
15.20	279.69	279.87	280.05	280.23	280.41	280.59	280.77	280.95	281.13	281.31	281.49	15.20
15.30	281.49	281.67	281.85	282.04	282.22	282.40	282.58	282.76	282.94	283.12	283.30	15.30
15.40	283.30	283.48	283.66	283.84	284.02	284.20	284.38	284.56	284.74	284.92	285.10	15.40
15.50	285.10	285.28	285.46	285.64	285.82	286.01	286.19	286.37	286.55	286.73	286.91	15.50
15.60	286.91	287.09	287.27	287.45	287.63	287.81	287.99	288.17	288.35	288.53	288.71	15.60
15.70	288.71	288.89	289.07	289.25	289.43	289.61	289.80	289.98	290.16	290.34	290.52	15.70
15.80	290.52	290.70	290.88	291.06	291.24	291.42	291.60	291.78	291.96	292.14	292.32	15.80
15.90	292.32	292.50	292.68	292.86	293.05	293.23	293.41	293.59	293.77	293.95	294.13	15.90
16.00	294.13	294.31	294.49	294.67	294.85	295.03	295.21	295.39	295.57	295.75	295.93	16.00
16.10	295.93	296.11	296.30	296.48	296.66	296.84	297.02	297.20	297.38	297.56	297.74	16.10
16.20	297.74	297.92	298.10	298.28	298.46	298.64	298.82	299.00	299.19	299.37	299.55	16.20
16.30	299.55	299.73	299.91	300.09	300.27	300.45	300.63	300.81	300.99	301.17	301.35	16.30
16.40	301.35	301.53	301.71	301.89	302.08	302.26	302.44	302.62	302.80	302.98	303.16	16.40
16.50	303.16	303.34	303.52	303.70	303.88	304.06	304.24	304.42	304.61	304.79	304.97	16.50
16.60	304.97	305.15	305.33	305.51	305.69	305.87	306.05	306.23	306.41	306.59	306.77	16.60
16.70	306.77	306.95	307.14	307.32	307.50	307.68	307.86	308.04	308.22	308.40	308.58	16.70
16.80	308.58	308.76	308.94	309.12	309.30	309.48	309.67	309.85	310.03	310.21	310.39	16.80
16.90	310.39	310.57	310.75	310.93	311.11	311.29	311.47	311.65	311.83	312.02	312.20	16.90
17.00	312.20	312.38	312.56	312.74	312.92	313.10	313.28	313.46	313.64	313.82	314.00	17.00
17.10	314.00	314.19	314.37	314.55	314.73	314.91	315.09	315.27	315.45	315.63	315.81	17.10
17.20	315.81	315.99	316.17	316.36	316.54	316.72	316.90	317.08	317.26	317.44	317.62	17.20
17.30	317.62	317.80	317.98	318.16	318.34	318.53	318.71	318.89	319.07	319.25	319.43	17.30
17.40	319.43	319.61	319.79	319.97	320.15	320.33	320.51	320.70	320.88	321.06	321.24	17.40
17.50	321.24	321.42	321.60	321.78	321.96	322.14	322.32	322.50	322.69	322.87	323.05	17.50
17.60	323.05	323.23	323.41	323.59	323.77	323.95	324.13	324.31	324.50	324.68	324.86	17.60
17.70	324.86	325.04	325.22	325.40	325.58	325.76	325.94	326.12	326.30	326.49	326.67	17.70
17.80	326.67	326.85	327.03	327.21	327.39	327.57	327.75	327.93	328.11	328.30	328.48	17.80
17.90	328.48	328.66	328.84	329.02	329.20	329.38	329.56	329.74	329.92	330.11	330.29	17.90
18.00	330.29	330.47	330.65	330.83	331.01	331.19	331.37	331.55	331.73	331.92	332.10	18.00

TABLE A6.2.1. *Type J thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
18.00	330.29	330.47	330.65	330.83	331.01	331.19	331.37	331.55	331.73	331.92	332.10	18.00
18.10	332.10	332.28	332.46	332.64	332.82	333.00	333.18	333.36	333.54	333.73	333.91	18.10
18.20	333.91	334.09	334.27	334.45	334.63	334.81	334.99	335.17	335.36	335.54	335.72	18.20
18.30	335.72	335.90	336.08	336.26	336.44	336.62	336.80	336.98	337.17	337.35	337.53	18.30
18.40	337.53	337.71	337.89	338.07	338.25	338.43	338.61	338.80	338.98	339.16	339.34	18.40
18.50	339.34	339.52	339.70	339.88	340.06	340.24	340.43	340.61	340.79	340.97	341.15	18.50
18.60	341.15	341.33	341.51	341.69	341.87	342.06	342.24	342.42	342.60	342.78	342.96	18.60
18.70	342.96	343.14	343.32	343.50	343.69	343.87	344.05	344.23	344.41	344.59	344.77	18.70
18.80	344.77	344.95	345.14	345.32	345.50	345.68	345.86	346.04	346.22	346.40	346.58	18.80
18.90	346.58	346.77	346.95	347.13	347.31	347.49	347.67	347.85	348.03	348.22	348.40	18.90
19.00	348.40	348.58	348.76	348.94	349.12	349.30	349.48	349.66	349.85	350.03	350.21	19.00
19.10	350.21	350.39	350.57	350.75	350.93	351.11	351.30	351.48	351.66	351.84	352.02	19.10
19.20	352.02	352.20	352.38	352.56	352.75	352.93	353.11	353.29	353.47	353.65	353.83	19.20
19.30	353.83	354.01	354.20	354.38	354.56	354.74	354.92	355.10	355.28	355.46	355.65	19.30
19.40	355.65	355.83	356.01	356.19	356.37	356.55	356.73	356.91	357.10	357.28	357.46	19.40
19.50	357.46	357.64	357.82	358.00	358.18	358.36	358.55	358.73	358.91	359.09	359.27	19.50
19.60	359.27	359.45	359.63	359.81	360.00	360.18	360.36	360.54	360.72	360.90	361.08	19.60
19.70	361.08	361.26	361.45	361.63	361.81	361.99	362.17	362.35	362.53	362.71	362.90	19.70
19.80	362.90	363.08	363.26	363.44	363.62	363.80	363.98	364.17	364.35	364.53	364.71	19.80
19.90	364.71	364.89	365.07	365.25	365.43	365.62	365.80	365.98	366.16	366.34	366.52	19.90
20.00	366.52	366.70	366.89	367.07	367.25	367.43	367.61	367.79	367.97	368.15	368.34	20.00
20.10	368.34	368.52	368.70	368.88	369.06	369.24	369.42	369.61	369.79	369.97	370.15	20.10
20.20	370.15	370.33	370.51	370.69	370.87	371.06	371.24	371.42	371.60	371.78	371.96	20.20
20.30	371.96	372.14	372.33	372.51	372.69	372.87	373.05	373.23	373.41	373.59	373.78	20.30
20.40	373.78	373.96	374.14	374.32	374.50	374.68	374.86	375.05	375.23	375.41	375.59	20.40
20.50	375.59	375.77	375.95	376.13	376.32	376.50	376.68	376.86	377.04	377.22	377.40	20.50
20.60	377.40	377.58	377.77	377.95	378.13	378.31	378.49	378.67	378.85	379.04	379.22	20.60
20.70	379.22	379.40	379.58	379.76	379.94	380.12	380.31	380.49	380.67	380.85	381.03	20.70
20.80	381.03	381.21	381.39	381.57	381.76	381.94	382.12	382.30	382.48	382.66	382.84	20.80
20.90	382.84	383.03	383.21	383.39	383.57	383.75	383.93	384.11	384.30	384.48	384.66	20.90
21.00	384.66	384.84	385.02	385.20	385.38	385.57	385.75	385.93	386.11	386.29	386.47	21.00
21.10	386.47	386.65	386.83	387.02	387.20	387.38	387.56	387.74	387.92	388.10	388.29	21.10
21.20	388.29	388.47	388.65	388.83	389.01	389.19	389.37	389.56	389.74	389.92	390.10	21.20
21.30	390.10	390.28	390.46	390.64	390.83	391.01	391.19	391.37	391.55	391.73	391.91	21.30
21.40	391.91	392.09	392.28	392.46	392.64	392.82	393.00	393.18	393.36	393.55	393.73	21.40
21.50	393.73	393.91	394.09	394.27	394.45	394.63	394.82	395.00	395.18	395.36	395.54	21.50
21.60	395.54	395.72	395.90	396.08	396.27	396.45	396.63	396.81	396.99	397.17	397.35	21.60
21.70	397.35	397.54	397.72	397.90	398.08	398.26	398.44	398.62	398.81	398.99	399.17	21.70
21.80	399.17	399.35	399.53	399.71	399.89	400.07	400.26	400.44	400.62	400.80	400.98	21.80
21.90	400.98	401.16	401.34	401.53	401.71	401.89	402.07	402.25	402.43	402.61	402.79	21.90
22.00	402.79	402.98	403.16	403.34	403.52	403.70	403.88	404.06	404.25	404.43	404.61	22.00
22.10	404.61	404.79	404.97	405.15	405.33	405.51	405.70	405.88	406.06	406.24	406.42	22.10
22.20	406.42	406.60	406.78	406.97	407.15	407.33	407.51	407.69	407.87	408.05	408.23	22.20
22.30	408.23	408.42	408.60	408.78	408.96	409.14	409.32	409.50	409.69	409.87	410.05	22.30
22.40	410.05	410.23	410.41	410.59	410.77	410.95	411.14	411.32	411.50	411.68	411.86	22.40
22.50	411.86	412.04	412.22	412.40	412.59	412.77	412.95	413.13	413.31	413.49	413.67	22.50
22.60	413.67	413.85	414.04	414.22	414.40	414.58	414.76	414.94	415.12	415.30	415.49	22.60
22.70	415.49	415.67	415.85	416.03	416.21	416.39	416.57	416.75	416.94	417.12	417.30	22.70
22.80	417.30	417.48	417.66	417.84	418.02	418.20	418.39	418.57	418.75	418.93	419.11	22.80
22.90	419.11	419.29	419.47	419.65	419.83	420.02	420.20	420.38	420.56	420.74	420.92	22.90
23.00	420.92	421.10	421.28	421.47	421.65	421.83	422.01	422.19	422.37	422.55	422.73	23.00
23.10	422.73	422.91	423.10	423.28	423.46	423.64	423.82	424.00	424.18	424.36	424.55	23.10
23.20	424.55	424.73	424.91	425.09	425.27	425.45	425.63	425.81	425.99	426.18	426.36	23.20
23.30	426.36	426.54	426.72	426.90	427.08	427.26	427.44	427.62	427.81	427.99	428.17	23.30
23.40	428.17	428.35	428.53	428.71	428.89	429.07	429.25	429.43	429.62	429.80	429.98	23.40
23.50	429.98	430.16	430.34	430.52	430.70	430.88	431.06	431.25	431.43	431.61	431.79	23.50
23.60	431.79	431.97	432.15	432.33	432.51	432.69	432.87	433.06	433.24	433.42	433.60	23.60
23.70	433.60	433.78	433.96	434.14	434.32	434.50	434.68	434.87	435.05	435.23	435.41	23.70
23.80	435.41	435.59	435.77	435.95	436.13	436.31	436.49	436.67	436.86	437.04	437.22	23.80
23.90	437.22	437.40	437.58	437.76	437.94	438.12	438.30	438.48	438.66	438.85	439.03	23.90
24.00	439.03	439.21	439.39	439.57	439.75	439.93	440.11	440.29	440.47	440.65	440.84	24.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. *Type J thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
24.00	439.03	439.21	439.39	439.57	439.75	439.93	440.11	440.29	440.47	440.65	440.84	24.00
24.10	440.84	441.02	441.20	441.38	441.56	441.74	441.92	442.10	442.28	442.46	442.64	24.10
24.20	442.64	442.82	443.00	443.19	443.37	443.55	443.73	443.91	444.09	444.27	444.45	24.20
24.30	444.64	444.83	444.81	444.99	445.17	445.36	445.54	445.72	445.90	446.08	446.26	24.30
24.40	446.26	446.44	446.62	446.80	446.98	447.16	447.34	447.52	447.70	447.89	448.07	24.40
24.50	448.07	448.25	448.43	448.61	448.79	448.97	449.15	449.33	449.51	449.69	449.87	24.50
24.60	449.87	450.05	450.23	450.41	450.59	450.78	450.96	451.14	451.32	451.50	451.68	24.60
24.70	451.68	451.86	452.04	452.22	452.40	452.58	452.76	452.94	453.12	453.30	453.48	24.70
24.80	453.48	453.66	453.85	454.03	454.21	454.39	454.57	454.75	454.93	455.11	455.29	24.80
24.90	455.29	455.47	455.65	455.83	456.01	456.19	456.37	456.55	456.73	456.91	457.09	24.90
25.00	457.09	457.27	457.45	457.64	457.82	458.00	458.18	458.36	458.54	458.72	458.90	25.00
25.10	458.90	459.08	459.26	459.44	459.62	459.80	459.98	460.16	460.34	460.52	460.70	25.10
25.20	460.70	460.88	461.06	461.24	461.42	461.60	461.78	461.96	462.14	462.32	462.50	25.20
25.30	462.50	462.68	462.87	463.05	463.23	463.41	463.59	463.77	463.95	464.13	464.31	25.30
25.40	464.31	464.49	464.67	464.85	465.03	465.21	465.39	465.57	465.75	465.93	466.11	25.40
25.50	466.11	466.29	466.47	466.65	466.83	467.01	467.19	467.37	467.55	467.73	467.91	25.50
25.60	467.91	468.09	468.27	468.45	468.63	468.81	468.99	469.17	469.35	469.53	469.71	25.60
25.70	469.71	469.89	470.07	470.25	470.43	470.61	470.79	470.97	471.15	471.33	471.51	25.70
25.80	471.51	471.69	471.87	472.05	472.23	472.41	472.59	472.77	472.95	473.13	473.31	25.80
25.90	473.31	473.49	473.67	473.85	474.03	474.21	474.39	474.57	474.75	474.93	475.11	25.90
26.00	475.11	475.29	475.47	475.65	475.83	476.01	476.19	476.37	476.55	476.73	476.91	26.00
26.10	476.91	477.09	477.27	477.45	477.63	477.81	477.99	478.17	478.34	478.52	478.70	26.10
26.20	478.70	478.88	479.06	479.24	479.42	479.60	479.78	479.96	480.14	480.32	480.50	26.20
26.30	480.50	480.68	480.86	481.04	481.22	481.40	481.58	481.76	481.94	482.12	482.30	26.30
26.40	482.30	482.48	482.66	482.84	483.01	483.19	483.37	483.55	483.73	483.91	484.09	26.40
26.50	484.09	484.27	484.45	484.63	484.81	484.99	485.17	485.35	485.53	485.71	485.89	26.50
26.60	485.89	486.07	486.24	486.42	486.60	486.78	486.96	487.14	487.32	487.50	487.68	26.60
26.70	487.68	487.86	488.04	488.22	488.40	488.58	488.76	488.93	489.11	489.29	489.47	26.70
26.80	489.47	489.65	489.83	490.01	490.19	490.37	490.55	490.73	490.91	491.08	491.26	26.80
26.90	491.26	491.44	491.62	491.80	491.98	492.16	492.34	492.52	492.70	492.88	493.05	26.90
27.00	493.05	493.23	493.41	493.59	493.77	493.95	494.13	494.31	494.49	494.67	494.85	27.00
27.10	494.85	495.02	495.20	495.38	495.56	495.74	495.92	496.10	496.28	496.46	496.63	27.10
27.20	496.63	496.81	496.99	497.17	497.35	497.53	497.71	497.89	498.06	498.24	498.42	27.20
27.30	498.42	498.60	498.78	498.96	499.14	499.32	499.50	499.67	499.85	500.03	500.21	27.30
27.40	500.21	500.39	500.57	500.75	500.92	501.10	501.28	501.46	501.64	501.82	502.00	27.40
27.50	502.00	502.18	502.35	502.53	502.71	502.89	503.07	503.25	503.43	503.60	503.78	27.50
27.60	503.78	503.96	504.14	504.32	504.50	504.67	504.85	505.03	505.21	505.39	505.57	27.60
27.70	505.57	505.75	505.92	506.10	506.28	506.46	506.64	506.82	506.99	507.17	507.35	27.70
27.80	507.35	507.53	507.71	507.89	508.06	508.24	508.42	508.60	508.78	508.95	509.13	27.80
27.90	509.13	509.31	509.49	509.67	509.85	510.02	510.20	510.38	510.56	510.74	510.91	27.90
28.00	510.91	511.09	511.27	511.45	511.63	511.80	511.98	512.16	512.34	512.52	512.69	28.00
28.10	512.69	512.87	513.05	513.23	513.41	513.58	513.76	513.94	514.12	514.30	514.47	28.10
28.20	514.47	514.65	514.83	515.01	515.19	515.36	515.54	515.72	515.90	516.08	516.25	28.20
28.30	516.25	516.43	516.61	516.79	516.96	517.14	517.32	517.50	517.67	517.85	518.03	28.30
28.40	518.03	518.21	518.39	518.56	518.74	518.92	519.10	519.27	519.45	519.63	519.81	28.40
28.50	519.81	519.98	520.16	520.34	520.52	520.69	520.87	521.05	521.23	521.40	521.58	28.50
28.60	521.58	521.76	521.94	522.11	522.29	522.47	522.65	522.82	523.00	523.18	523.36	28.60
28.70	523.36	523.53	523.71	523.89	524.06	524.24	524.42	524.60	524.77	524.95	525.13	28.70
28.80	525.13	525.31	525.48	525.66	525.84	526.01	526.19	526.37	526.55	526.72	526.90	28.80
28.90	526.90	527.08	527.25	527.43	527.61	527.79	527.96	528.14	528.32	528.49	528.67	28.90
29.00	528.67	528.85	529.02	529.20	529.38	529.56	529.73	529.91	530.09	530.26	530.44	29.00
29.10	530.44	530.62	530.79	530.97	531.15	531.32	531.50	531.68	531.85	532.03	532.21	29.10
29.20	532.21	532.38	532.56	532.74	532.92	533.09	533.27	533.45	533.62	533.80	533.98	29.20
29.30	533.98	534.15	534.33	534.50	534.68	534.86	535.03	535.21	535.39	535.56	535.74	29.30
29.40	535.74	535.92	536.09	536.27	536.45	536.62	536.80	536.98	537.15	537.33	537.51	29.40
29.50	537.51	537.68	537.86	538.03	538.21	538.39	538.56	538.74	538.92	539.09	539.27	29.50
29.60	539.27	539.44	539.62	539.80	539.97	540.15	540.33	540.50	540.68	540.85	541.03	29.60
29.70	541.03	541.21	541.38	541.56	541.73	541.91	542.09	542.26	542.44	542.61	542.79	29.70
29.80	542.79	542.97	543.14	543.32	543.49	543.67	543.85	544.02	544.20	544.37	544.55	29.80
29.90	544.55	544.73	544.90	545.08	545.25	545.43	545.60	545.78	545.96	546.13	546.31	29.90
30.00	546.31	546.48	546.66	546.83	547.01	547.19	547.36	547.54	547.71	547.89	548.06	30.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. *Type J thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
30.00	546.31	546.48	546.66	546.83	547.01	547.19	547.36	547.54	547.71	547.89	548.06	30.00
30.10	548.06	548.24	548.42	548.59	548.77	548.94	549.12	549.29	549.47	549.64	549.82	30.10
30.20	549.82	549.99	550.17	550.35	550.52	550.70	550.87	551.05	551.22	551.40	551.57	30.20
30.30	551.57	551.75	551.92	552.10	552.27	552.45	552.62	552.80	552.97	553.15	553.33	30.30
30.40	553.33	553.50	553.68	553.85	554.03	554.20	554.38	554.55	554.73	554.90	555.08	30.40
30.50	555.08	555.25	555.43	555.60	555.78	555.95	556.13	556.30	556.48	556.65	556.83	30.50
30.60	556.83	557.00	557.18	557.35	557.53	557.70	557.87	558.05	558.22	558.40	558.57	30.60
30.70	558.57	558.75	558.92	559.10	559.27	559.45	559.62	559.80	559.97	560.15	560.32	30.70
30.80	560.32	560.50	560.67	560.84	561.02	561.19	561.37	561.54	561.72	561.89	562.07	30.80
30.90	562.07	562.24	562.41	562.59	562.76	562.94	563.11	563.29	563.46	563.64	563.81	30.90
31.00	563.81	563.98	564.16	564.33	564.51	564.68	564.85	565.03	565.20	565.38	565.55	31.00
31.10	565.55	565.73	565.90	566.07	566.25	566.42	566.60	566.77	566.94	567.12	567.29	31.10
31.20	567.29	567.47	567.64	567.81	567.99	568.16	568.34	568.51	568.68	568.86	569.03	31.20
31.30	569.03	569.21	569.38	569.55	569.73	569.90	570.07	570.25	570.42	570.60	570.77	31.30
31.40	570.77	570.94	571.12	571.29	571.46	571.64	571.81	571.98	572.16	572.33	572.51	31.40
31.50	572.51	572.68	572.85	573.03	573.20	573.37	573.55	573.72	573.89	574.07	574.24	31.50
31.60	574.24	574.41	574.59	574.76	574.93	575.11	575.28	575.45	575.63	575.80	575.97	31.60
31.70	575.97	576.15	576.32	576.49	576.67	576.84	577.01	577.19	577.36	577.53	577.70	31.70
31.80	577.70	577.88	578.05	578.22	578.40	578.57	578.74	578.92	579.09	579.26	579.43	31.80
31.90	579.43	579.61	579.78	579.95	580.13	580.30	580.47	580.64	580.82	580.99	581.16	31.90
32.00	581.16	581.34	581.51	581.68	581.85	582.03	582.20	582.37	582.54	582.72	582.89	32.00
32.10	582.89	583.06	583.24	583.41	583.58	583.75	583.93	584.10	584.27	584.44	584.62	32.10
32.20	584.62	584.79	584.96	585.13	585.30	585.48	585.65	585.82	585.99	586.17	586.34	32.20
32.30	586.34	586.51	586.68	586.86	587.03	587.20	587.37	587.54	587.72	587.89	588.06	32.30
32.40	588.06	588.23	588.40	588.58	588.75	588.92	589.09	589.26	589.44	589.61	589.78	32.40
32.50	589.78	589.95	590.12	590.30	590.47	590.64	590.81	590.98	591.16	591.33	591.50	32.50
32.60	591.50	591.67	591.84	592.01	592.19	592.36	592.53	592.70	592.87	593.04	593.22	32.60
32.70	593.22	593.39	593.56	593.73	593.90	594.07	594.25	594.42	594.59	594.76	594.93	32.70
32.80	594.93	595.10	595.27	595.45	595.62	595.79	595.96	596.13	596.30	596.47	596.65	32.80
32.90	596.65	596.82	596.99	597.16	597.33	597.50	597.67	597.84	598.02	598.19	598.36	32.90
33.00	598.36	598.53	598.70	598.87	599.04	599.21	599.38	599.55	599.73	599.90	600.07	33.00
33.10	600.07	600.24	600.41	600.58	600.75	600.92	601.09	601.26	601.43	601.61	601.78	33.10
33.20	601.78	601.95	602.12	602.29	602.46	602.63	602.80	602.97	603.14	603.31	603.48	33.20
33.30	603.48	603.65	603.82	604.00	604.17	604.34	604.51	604.68	604.85	605.02	605.19	33.30
33.40	605.19	605.36	605.53	605.70	605.87	606.04	606.21	606.38	606.55	606.72	606.89	33.40
33.50	606.89	607.06	607.23	607.40	607.57	607.74	607.91	608.08	608.25	608.42	608.59	33.50
33.60	608.59	608.76	608.93	609.10	609.27	609.44	609.61	609.78	609.95	610.12	610.29	33.60
33.70	610.29	610.46	610.63	610.80	610.97	611.14	611.31	611.48	611.65	611.82	611.99	33.70
33.80	611.99	612.16	612.33	612.50	612.67	612.84	613.01	613.18	613.35	613.52	613.69	33.80
33.90	613.69	613.86	614.03	614.20	614.37	614.54	614.71	614.88	615.05	615.22	615.38	33.90
34.00	615.38	615.55	615.72	615.89	616.06	616.23	616.40	616.57	616.74	616.91	617.08	34.00
34.10	617.08	617.25	617.42	617.58	617.75	617.92	618.09	618.26	618.43	618.60	618.77	34.10
34.20	618.77	618.94	619.11	619.28	619.44	619.61	619.78	619.95	620.12	620.29	620.46	34.20
34.30	620.46	620.63	620.80	620.96	621.13	621.30	621.47	621.64	621.81	621.98	622.15	34.30
34.40	622.15	622.31	622.48	622.65	622.82	622.99	623.16	623.33	623.49	623.66	623.83	34.40
34.50	623.83	624.00	624.17	624.34	624.51	624.67	624.84	625.01	625.18	625.35	625.52	34.50
34.60	625.52	625.68	625.85	626.02	626.19	626.36	626.53	626.69	626.86	627.03	627.20	34.60
34.70	627.20	627.37	627.54	627.70	627.87	628.04	628.21	628.38	628.54	628.71	628.88	34.70
34.80	628.88	629.05	629.22	629.38	629.55	629.72	629.89	630.06	630.22	630.39	630.56	34.80
34.90	630.56	630.73	630.89	631.06	631.23	631.40	631.57	631.73	631.90	632.07	632.24	34.90
35.00	632.24	632.40	632.57	632.74	632.91	633.07	633.24	633.41	633.58	633.74	633.91	35.00
35.10	633.91	634.08	634.25	634.41	634.58	634.75	634.92	635.08	635.25	635.42	635.59	35.10
35.20	635.59	635.75	635.92	636.09	636.25	636.42	636.59	636.76	636.92	637.09	637.26	35.20
35.30	637.26	637.42	637.59	637.76	637.93	638.09	638.26	638.43	638.59	638.76	638.93	35.30
35.40	638.93	639.09	639.26	639.43	639.60	639.76	639.93	640.10	640.26	640.43	640.60	35.40
35.50	640.60	640.76	640.93	641.10	641.26	641.43	641.60	641.76	641.93	642.10	642.26	35.50
35.60	642.26	642.43	642.60	642.76	642.93	643.10	643.26	643.43	643.60	643.76	643.93	35.60
35.70	643.93	644.09	644.26	644.43	644.59	644.76	644.93	645.09	645.26	645.42	645.59	35.70
35.80	645.59	645.76	645.92	646.09	646.26	646.42	646.59	646.75	646.92	647.09	647.25	35.80
35.90	647.25	647.42	647.58	647.75	647.92	648.08	648.25	648.41	648.58	648.75	648.91	35.90
36.00	648.91	649.08	649.24	649.41	649.58	649.74	649.91	650.07	650.24	650.40	650.57	36.00

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
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TABLE A6.2.1. *Type J thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
36.00	648.91	649.08	649.24	649.41	649.58	649.74	649.91	650.07	650.24	650.40	650.57	36.00
36.10	650.57	650.74	650.90	651.07	651.23	651.40	651.56	651.73	651.90	652.06	652.23	36.10
36.20	652.23	652.39	652.56	652.72	652.89	653.05	653.22	653.38	653.55	653.72	653.88	36.20
36.30	653.88	654.05	654.21	654.38	654.54	654.71	654.87	655.04	655.20	655.37	655.53	36.30
36.40	655.53	655.70	655.86	656.03	656.19	656.36	656.52	656.69	656.85	657.02	657.18	36.40
36.50	657.18	657.35	657.51	657.68	657.84	658.01	658.17	658.34	658.50	658.67	658.83	36.50
36.60	658.83	659.00	659.16	659.33	659.49	659.66	659.82	659.99	660.15	660.32	660.48	36.60
36.70	660.48	660.65	660.81	660.97	661.14	661.30	661.47	661.63	661.80	661.96	662.13	36.70
36.80	662.13	662.29	662.46	662.62	662.78	662.95	663.11	663.28	663.44	663.61	663.77	36.80
36.90	663.77	663.93	664.10	664.26	664.43	664.59	664.76	664.92	665.08	665.25	665.41	36.90
37.00	665.41	665.58	665.74	665.90	666.07	666.23	666.40	666.56	666.72	666.89	667.05	37.00
37.10	667.05	667.22	667.38	667.54	667.71	667.87	668.04	668.20	668.36	668.53	668.69	37.10
37.20	668.69	668.86	669.02	669.18	669.35	669.51	669.67	669.84	670.00	670.17	670.33	37.20
37.30	670.33	670.49	670.66	670.82	670.98	671.15	671.31	671.47	671.64	671.80	671.96	37.30
37.40	671.96	672.13	672.29	672.45	672.62	672.78	672.94	673.11	673.27	673.43	673.60	37.40
37.50	673.60	673.76	673.92	674.09	674.25	674.41	674.58	674.74	674.90	675.07	675.23	37.50
37.60	675.23	675.39	675.56	675.72	675.88	676.05	676.21	676.37	676.53	676.70	676.86	37.60
37.70	676.86	677.02	677.19	677.35	677.51	677.67	677.84	678.00	678.16	678.33	678.49	37.70
37.80	678.49	678.65	678.81	678.98	679.14	679.30	679.47	679.63	679.79	679.95	680.12	37.80
37.90	680.12	680.28	680.44	680.60	680.77	680.93	681.09	681.25	681.42	681.58	681.74	37.90
38.00	681.74	681.90	682.07	682.23	682.39	682.55	682.72	682.88	683.04	683.20	683.36	38.00
38.10	683.36	683.53	683.69	683.85	684.01	684.18	684.34	684.50	684.66	684.82	684.99	38.10
38.20	684.99	685.15	685.31	685.47	685.64	685.80	685.96	686.12	686.28	686.45	686.61	38.20
38.30	686.61	686.77	686.93	687.09	687.26	687.42	687.58	687.74	687.90	688.06	688.23	38.30
38.40	688.23	688.39	688.55	688.71	688.87	689.04	689.20	689.36	689.52	689.68	689.84	38.40
38.50	689.84	690.01	690.17	690.33	690.49	690.65	690.81	690.97	691.14	691.30	691.46	38.50
38.60	691.46	691.62	691.78	691.94	692.11	692.27	692.43	692.59	692.75	692.91	693.07	38.60
38.70	693.07	693.23	693.40	693.56	693.72	693.88	694.04	694.20	694.36	694.52	694.69	38.70
38.80	694.69	694.85	695.01	695.17	695.33	695.49	695.65	695.81	695.97	696.14	696.30	38.80
38.90	696.30	696.46	696.62	696.78	696.94	697.10	697.26	697.42	697.58	697.75	697.91	38.90
39.00	697.91	698.07	698.23	698.39	698.55	698.71	698.87	699.03	699.19	699.35	699.51	39.00
39.10	699.51	699.68	699.84	700.00	700.16	700.32	700.48	700.64	700.80	700.96	701.12	39.10
39.20	701.12	701.28	701.44	701.60	701.76	701.92	702.08	702.24	702.40	702.57	702.73	39.20
39.30	702.73	702.89	703.05	703.21	703.37	703.53	703.69	703.85	704.01	704.17	704.33	39.30
39.40	704.33	704.49	704.65	704.81	704.97	705.13	705.29	705.45	705.61	705.77	705.93	39.40
39.50	705.93	706.09	706.25	706.41	706.57	706.73	706.89	707.05	707.21	707.37	707.53	39.50
39.60	707.53	707.69	707.85	708.01	708.17	708.33	708.49	708.65	708.81	708.97	709.13	39.60
39.70	709.13	709.29	709.45	709.61	709.77	709.93	710.09	710.25	710.41	710.57	710.73	39.70
39.80	710.73	710.89	711.05	711.21	711.37	711.53	711.69	711.85	712.01	712.17	712.32	39.80
39.90	712.32	712.48	712.64	712.80	712.96	713.12	713.28	713.44	713.60	713.76	713.92	39.90
40.00	713.92	714.08	714.24	714.40	714.56	714.72	714.88	715.04	715.19	715.35	715.51	40.00
40.10	715.51	715.67	715.83	715.99	716.15	716.31	716.47	716.63	716.79	716.95	717.11	40.10
40.20	717.11	717.26	717.42	717.58	717.74	717.90	718.06	718.22	718.38	718.54	718.70	40.20
40.30	718.70	718.85	719.01	719.17	719.33	719.49	719.65	719.81	719.97	720.13	720.29	40.30
40.40	720.29	720.44	720.60	720.76	720.92	721.08	721.24	721.40	721.56	721.71	721.87	40.40
40.50	721.87	722.03	722.19	722.35	722.51	722.67	722.83	722.98	723.14	723.30	723.46	40.50
40.60	723.46	723.62	723.78	723.94	724.09	724.25	724.41	724.57	724.73	724.89	725.05	40.60
40.70	725.05	725.20	725.36	725.52	725.68	725.84	726.00	726.16	726.31	726.47	726.63	40.70
40.80	726.63	726.79	726.95	727.11	727.26	727.42	727.58	727.74	727.90	728.06	728.21	40.80
40.90	728.21	728.37	728.53	728.69	728.85	729.00	729.16	729.32	729.48	729.64	729.80	40.90
41.00	729.80	729.95	730.11	730.27	730.43	730.59	730.74	730.90	731.06	731.22	731.38	41.00
41.10	731.38	731.53	731.69	731.85	732.01	732.17	732.32	732.48	732.64	732.80	732.96	41.10
41.20	732.96	733.11	733.27	733.43	733.59	733.75	733.90	734.06	734.22	734.38	734.53	41.20
41.30	734.53	734.69	734.85	735.01	735.17	735.32	735.48	735.64	735.80	735.95	736.11	41.30
41.40	736.11	736.27	736.43	736.59	736.74	736.90	737.06	737.22	737.37	737.53	737.69	41.40
41.50	737.69	737.85	738.00	738.16	738.32	738.48	738.63	738.79	738.95	739.11	739.26	41.50
41.60	739.26	739.42	739.58	739.74	739.89	740.05	740.21	740.37	740.52	740.68	740.84	41.60
41.70	740.84	741.00	741.15	741.31	741.47	741.62	741.78	741.94	742.10	742.25	742.41	41.70
41.80	742.41	742.57	742.73	742.88	743.04	743.20	743.35	743.51	743.67	743.83	743.98	41.80
41.90	743.98	744.14	744.30	744.45	744.61	744.77	744.93	745.08	745.24	745.40	745.55	41.90
42.00	745.55	745.71	745.87	746.03	746.18	746.34	746.50	746.65	746.81	746.97	747.12	42.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. *Type J thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPITS 1968)												
42.00	745.55	745.71	745.87	746.03	746.18	746.34	746.50	746.65	746.81	746.97	747.12	42.00
42.10	747.12	747.28	747.44	747.60	747.75	747.91	748.07	748.22	748.38	748.54	748.69	42.10
42.20	748.69	748.85	749.01	749.16	749.32	749.48	749.64	749.79	749.95	750.11	750.26	42.20
42.30	750.26	750.42	750.58	750.73	750.89	751.05	751.20	751.36	751.52	751.67	751.83	42.30
42.40	751.83	751.99	752.14	752.30	752.46	752.61	752.77	752.93	753.08	753.24	753.40	42.40
42.50	753.40	753.55	753.71	753.87	754.02	754.18	754.34	754.49	754.65	754.81	754.96	42.50
42.60	754.96	755.12	755.28	755.43	755.59	755.75	755.90	756.06	756.22	756.37	756.53	42.60
42.70	756.53	756.68	756.84	757.00	757.15	757.31	757.47	757.62	757.78	757.94	758.09	42.70
42.80	758.09	758.25	758.41	758.56	758.72	758.87	759.03	759.19	759.34	759.50	759.66	42.80
42.90	759.66	759.81	759.97									42.90
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. *Type J thermocouples extended range—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPITS 1968)												
42.90				760.13	760.28	760.43	760.59	760.74	760.90	761.06	761.22	42.90
43.00	761.22	761.38	761.53	761.69	761.85	762.00	762.16	762.31	762.47	762.63	762.78	43.00
43.10	762.78	762.94	763.09	763.25	763.41	763.56	763.72	763.87	764.03	764.19	764.34	43.10
43.20	764.34	764.50	764.65	764.81	764.97	765.12	765.28	765.43	765.59	765.75	765.90	43.20
43.30	765.90	766.06	766.21	766.37	766.53	766.68	766.84	766.99	767.15	767.30	767.46	43.30
43.40	767.46	767.62	767.77	767.93	768.08	768.24	768.39	768.55	768.71	768.86	769.02	43.40
43.50	769.02	769.17	769.33	769.48	769.64	769.80	769.95	770.11	770.26	770.42	770.57	43.50
43.60	770.57	770.73	770.88	771.04	771.20	771.35	771.51	771.66	771.82	771.97	772.13	43.60
43.70	772.13	772.28	772.44	772.60	772.75	772.91	773.06	773.22	773.37	773.53	773.68	43.70
43.80	773.68	773.84	773.99	774.15	774.30	774.46	774.62	774.77	774.93	775.08	775.24	43.80
43.90	775.24	775.39	775.55	775.70	775.86	776.01	776.17	776.32	776.48	776.63	776.79	43.90
44.00	776.79	776.94	777.10	777.26	777.41	777.57	777.72	777.88	778.03	778.19	778.34	44.00
44.10	778.34	778.50	778.65	778.81	778.96	779.12	779.27	779.43	779.58	779.74	779.89	44.10
44.20	779.89	780.05	780.20	780.36	780.51	780.67	780.82	780.98	781.13	781.29	781.44	44.20
44.30	781.44	781.60	781.75	781.91	782.06	782.22	782.37	782.53	782.68	782.84	782.99	44.30
44.40	782.99	783.15	783.30	783.46	783.61	783.77	783.92	784.08	784.23	784.39	784.54	44.40
44.50	784.54	784.70	784.85	785.01	785.16	785.32	785.47	785.63	785.78	785.94	786.09	44.50
44.60	786.09	786.25	786.40	786.56	786.71	786.87	787.02	787.18	787.33	787.49	787.64	44.60
44.70	787.64	787.80	787.95	788.11	788.26	788.42	788.57	788.73	788.88	789.04	789.19	44.70
44.80	789.19	789.35	789.50	789.66	789.81	789.97	790.12	790.28	790.43	790.59	790.74	44.80
44.90	790.74	790.90	791.05	791.21	791.36	791.51	791.67	791.82	791.98	792.13	792.29	44.90
45.00	792.29	792.44	792.60	792.75	792.91	793.06	793.22	793.37	793.53	793.68	793.84	45.00
45.10	793.84	793.99	794.15	794.30	794.46	794.61	794.77	794.92	795.08	795.23	795.38	45.10
45.20	795.38	795.54	795.69	795.85	796.00	796.16	796.31	796.47	796.62	796.78	796.93	45.20
45.30	796.93	797.09	797.24	797.40	797.55	797.71	797.86	798.02	798.17	798.33	798.48	45.30
45.40	798.48	798.63	798.79	798.94	799.10	799.25	799.41	799.56	799.72	799.87	800.03	45.40
45.50	800.03	800.18	800.34	800.49	800.65	800.80	800.96	801.11	801.27	801.42	801.58	45.50
45.60	801.58	801.73	801.88	802.04	802.19	802.35	802.50	802.66	802.81	802.97	803.12	45.60
45.70	803.12	803.28	803.43	803.59	803.74	803.90	804.05	804.21	804.36	804.52	804.67	45.70
45.80	804.67	804.83	804.98	805.13	805.29	805.44	805.60	805.75	805.91	806.06	806.22	45.80
45.90	806.22	806.37	806.53	806.68	806.84	806.99	807.15	807.30	807.46	807.61	807.77	45.90
46.00	807.77	807.92	808.08	808.23	808.39	808.54	808.70	808.85	809.01	809.16	809.31	46.00
46.10	809.31	809.47	809.62	809.78	809.93	810.09	810.24	810.40	810.55	810.71	810.86	46.10
46.20	810.86	811.02	811.17	811.33	811.48	811.64	811.79	811.95	812.10	812.26	812.41	46.20
46.30	812.41	812.57	812.72	812.88	813.03	813.19	813.34	813.50	813.65	813.81	813.96	46.30
46.40	813.96	814.12	814.27	814.43	814.58	814.74	814.89	815.05	815.20	815.36	815.51	46.40
46.50	815.51	815.67	815.82	815.98	816.13	816.28	816.44	816.59	816.75	816.90	817.06	46.50
46.60	817.06	817.21	817.37	817.52	817.68	817.83	817.99	818.14	818.30	818.45	818.61	46.60
46.70	818.61	818.77	818.92	819.08	819.23	819.39	819.54	819.70	819.85	820.01	820.16	46.70
46.80	820.16	820.32	820.47	820.63	820.78	820.94	821.09	821.25	821.40	821.56	821.71	46.80
46.90	821.71	821.87	822.02	822.18	822.33	822.49	822.64	822.80	822.95	823.11	823.26	46.90
47.00	823.26	823.42	823.57	823.73	823.88	824.04	824.19	824.35	824.50	824.66	824.82	47.00
47.10	824.82	824.97	825.13	825.28	825.44	825.59	825.75	825.90	826.06	826.21	826.37	47.10
47.20	826.37	826.52	826.68	826.83	826.99	827.14	827.30	827.45	827.61	827.77	827.92	47.20
47.30	827.92	828.08	828.23	828.39	828.54	828.70	828.85	829.01	829.16	829.32	829.47	47.30
47.40	829.47	829.63	829.79	829.94	830.10	830.25	830.41	830.56	830.72	830.87	831.03	47.40
47.50	831.03	831.18	831.34	831.50	831.65	831.81	831.96	832.12	832.27	832.43	832.58	47.50
47.60	832.58	832.74	832.90	833.05	833.21	833.36	833.52	833.67	833.83	833.98	834.14	47.60
47.70	834.14	834.30	834.45	834.61	834.76	834.92	835.07	835.23	835.39	835.54	835.70	47.70
47.80	835.70	835.85	836.01	836.16	836.32	836.48	836.63	836.79	836.94	837.10	837.25	47.80
47.90	837.25	837.41	837.57	837.72	837.88	838.03	838.19	838.34	838.50	838.66	838.81	47.90
48.00	838.81	838.97	839.12	839.28	839.44	839.59	839.75	839.90	840.06	840.21	840.37	48.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. *Type J thermocouples extended range—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
48.00	838.81	838.97	839.12	839.28	839.44	839.59	839.75	839.90	840.06	840.21	840.37	48.00
48.10	840.37	840.53	840.68	840.84	840.99	841.15	841.31	841.46	841.62	841.77	841.93	48.10
48.20	841.93	842.09	842.24	842.40	842.55	842.71	842.87	843.02	843.18	843.33	843.49	48.20
48.30	843.49	843.65	843.80	843.96	844.12	844.27	844.43	844.58	844.74	844.90	845.05	48.30
48.40	845.05	845.21	845.36	845.52	845.68	845.83	845.99	846.15	846.30	846.46	846.61	48.40
48.50	846.61	846.77	846.93	847.08	847.24	847.40	847.55	847.71	847.87	848.02	848.18	48.50
48.60	848.18	848.33	848.49	848.65	848.80	848.96	849.12	849.27	849.43	849.59	849.74	48.60
48.70	849.74	849.90	850.06	850.21	850.37	850.52	850.68	850.84	850.99	851.15	851.31	48.70
48.80	851.31	851.46	851.62	851.78	851.93	852.09	852.25	852.40	852.56	852.72	852.87	48.80
48.90	852.87	853.03	853.19	853.34	853.50	853.66	853.81	853.97	854.13	854.28	854.44	48.90
49.00	854.44	854.60	854.75	854.91	855.07	855.22	855.38	855.54	855.70	855.85	856.01	49.00
49.10	856.01	856.17	856.32	856.48	856.64	856.79	856.95	857.11	857.26	857.42	857.58	49.10
49.20	857.58	857.74	857.89	858.05	858.21	858.36	858.52	858.68	858.83	858.99	859.15	49.20
49.30	859.15	859.31	859.46	859.62	859.78	859.93	860.09	860.25	860.41	860.56	860.72	49.30
49.40	860.72	860.88	861.03	861.19	861.35	861.51	861.66	861.82	861.98	862.14	862.29	49.40
49.50	862.29	862.45	862.61	862.76	862.92	863.08	863.24	863.39	863.55	863.71	863.87	49.50
49.60	863.87	864.02	864.18	864.34	864.50	864.65	864.81	864.97	865.13	865.28	865.44	49.60
49.70	865.44	865.60	865.76	865.91	866.07	866.23	866.39	866.54	866.70	866.86	867.02	49.70
49.80	867.02	867.17	867.33	867.49	867.65	867.81	867.96	868.12	868.28	868.44	868.59	49.80
49.90	868.59	868.75	868.91	869.07	869.23	869.38	869.54	869.70	869.86	870.01	870.17	49.90
50.00	870.17	870.33	870.49	870.65	870.80	870.96	871.12	871.28	871.44	871.59	871.75	50.00
50.10	871.75	871.91	872.07	872.23	872.38	872.54	872.70	872.86	873.02	873.17	873.33	50.10
50.20	873.33	873.49	873.65	873.81	873.97	874.12	874.28	874.44	874.60	874.76	874.92	50.20
50.30	874.92	875.07	875.23	875.39	875.55	875.71	875.86	876.02	876.18	876.34	876.50	50.30
50.40	876.50	876.66	876.82	876.97	877.13	877.29	877.45	877.61	877.77	877.92	878.08	50.40
50.50	878.08	878.24	878.40	878.56	878.72	878.88	879.03	879.19	879.35	879.51	879.67	50.50
50.60	879.67	879.83	879.99	880.14	880.30	880.46	880.62	880.78	880.94	881.10	881.26	50.60
50.70	881.26	881.41	881.57	881.73	881.89	882.05	882.21	882.37	882.53	882.69	882.84	50.70
50.80	882.84	883.00	883.16	883.32	883.48	883.64	883.80	883.96	884.12	884.28	884.43	50.80
50.90	884.43	884.59	884.75	884.91	885.07	885.23	885.39	885.55	885.71	885.87	886.03	50.90
51.00	886.03	886.18	886.34	886.50	886.66	886.82	886.98	887.14	887.30	887.46	887.62	51.00
51.10	887.62	887.78	887.94	888.10	888.26	888.41	888.57	888.73	888.89	889.05	889.21	51.10
51.20	889.21	889.37	889.53	889.69	889.85	890.01	890.17	890.33	890.49	890.65	890.81	51.20
51.30	890.81	890.97	891.13	891.29	891.45	891.60	891.76	891.92	892.08	892.24	892.40	51.30
51.40	892.40	892.56	892.72	892.88	893.04	893.20	893.36	893.52	893.68	893.84	894.00	51.40
51.50	894.00	894.16	894.32	894.48	894.64	894.80	894.96	895.12	895.28	895.44	895.60	51.50
51.60	895.60	895.76	895.92	896.08	896.24	896.40	896.56	896.72	896.88	897.04	897.20	51.60
51.70	897.20	897.36	897.52	897.68	897.84	898.00	898.16	898.32	898.48	898.64	898.80	51.70
51.80	898.80	898.96	899.12	899.28	899.44	899.61	899.77	899.93	900.09	900.25	900.41	51.80
51.90	900.41	900.57	900.73	900.89	901.05	901.21	901.37	901.53	901.69	901.85	902.01	51.90
52.00	902.01	902.17	902.33	902.49	902.65	902.82	902.98	903.14	903.30	903.46	903.62	52.00
52.10	903.62	903.78	903.94	904.10	904.26	904.42	904.58	904.74	904.91	905.07	905.23	52.10
52.20	905.23	905.39	905.55	905.71	905.87	906.03	906.19	906.35	906.51	906.68	906.84	52.20
52.30	906.84	907.00	907.16	907.32	907.48	907.64	907.80	907.96	908.12	908.29	908.45	52.30
52.40	908.45	908.61	908.77	908.93	909.09	909.25	909.41	909.58	909.74	909.90	910.06	52.40
52.50	910.06	910.22	910.38	910.54	910.70	910.87	911.03	911.19	911.35	911.51	911.67	52.50
52.60	911.67	911.83	912.00	912.16	912.32	912.48	912.64	912.80	912.97	913.13	913.29	52.60
52.70	913.29	913.45	913.61	913.77	913.93	914.10	914.26	914.42	914.58	914.74	914.91	52.70
52.80	914.91	915.07	915.23	915.39	915.55	915.71	915.88	916.04	916.20	916.36	916.52	52.80
52.90	916.52	916.69	916.85	917.01	917.17	917.33	917.50	917.66	917.82	917.98	918.14	52.90
53.00	918.14	918.31	918.47	918.63	918.79	918.95	919.12	919.28	919.44	919.60	919.76	53.00
53.10	919.76	919.93	920.09	920.25	920.41	920.58	920.74	920.90	921.06	921.22	921.39	53.10
53.20	921.39	921.55	921.71	921.87	922.04	922.20	922.36	922.52	922.69	922.85	923.01	53.20
53.30	923.01	923.17	923.34	923.50	923.66	923.82	923.99	924.15	924.31	924.47	924.64	53.30
53.40	924.64	924.80	924.96	925.12	925.29	925.45	925.61	925.78	925.94	926.10	926.26	53.40
53.50	926.26	926.43	926.59	926.75	926.92	927.08	927.24	927.40	927.57	927.73	927.89	53.50
53.60	927.89	928.06	928.22	928.38	928.54	928.71	928.87	929.03	929.20	929.36	929.52	53.60
53.70	929.52	929.69	929.85	930.01	930.18	930.34	930.50	930.66	930.83	930.99	931.15	53.70
53.80	931.15	931.32	931.48	931.64	931.81	931.97	932.13	932.30	932.46	932.62	932.79	53.80
53.90	932.79	932.95	933.11	933.28	933.44	933.60	933.77	933.93	934.10	934.26	934.42	53.90
54.00	934.42	934.59	934.75	934.91	935.08	935.24	935.40	935.57	935.73	935.89	936.06	54.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. Type J thermocouples extended range—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
54.00	934.42	934.59	934.75	934.91	935.08	935.24	935.40	935.57	935.73	935.89	936.06	54.00
54.10	936.06	936.22	936.39	936.55	936.71	936.88	937.04	937.20	937.37	937.53	937.70	54.10
54.20	937.70	937.86	938.02	938.19	938.35	938.52	938.68	938.84	939.01	939.17	939.34	54.20
54.30	939.34	939.50	939.66	939.83	939.99	940.16	940.32	940.48	940.65	940.81	940.98	54.30
54.40	940.98	941.14	941.30	941.47	941.63	941.80	941.96	942.13	942.29	942.45	942.62	54.40
54.50	942.62	942.78	942.95	943.11	943.28	943.44	943.60	943.77	943.93	944.10	944.26	54.50
54.60	944.26	944.43	944.59	944.76	944.92	945.08	945.25	945.41	945.58	945.74	945.91	54.60
54.70	945.91	946.07	946.24	946.40	946.57	946.73	946.89	947.06	947.22	947.39	947.55	54.70
54.80	947.55	947.72	947.88	948.05	948.21	948.38	948.54	948.71	948.87	949.04	949.20	54.80
54.90	949.20	949.37	949.53	949.70	949.86	950.03	950.19	950.36	950.52	950.69	950.85	54.90
55.00	950.85	951.02	951.18	951.35	951.51	951.68	951.84	952.01	952.17	952.34	952.50	55.00
55.10	952.50	952.67	952.83	953.00	953.16	953.33	953.49	953.66	953.82	953.99	954.15	55.10
55.20	954.15	954.32	954.48	954.65	954.82	954.98	955.15	955.31	955.48	955.64	955.81	55.20
55.30	955.81	955.97	956.14	956.30	956.47	956.64	956.80	956.97	957.13	957.30	957.46	55.30
55.40	957.46	957.63	957.79	957.96	958.13	958.29	958.46	958.62	958.79	958.95	959.12	55.40
55.50	959.12	959.29	959.45	959.62	959.78	959.95	960.11	960.28	960.45	960.61	960.78	55.50
55.60	960.78	960.94	961.11	961.28	961.44	961.61	961.77	961.94	962.11	962.27	962.44	55.60
55.70	962.44	962.60	962.77	962.94	963.10	963.27	963.43	963.60	963.77	963.93	964.10	55.70
55.80	964.10	964.27	964.43	964.60	964.76	964.93	965.10	965.26	965.43	965.60	965.76	55.80
55.90	965.76	965.93	966.09	966.26	966.43	966.59	966.76	966.93	967.09	967.26	967.43	55.90
56.00	967.43	967.59	967.76	967.92	968.09	968.26	968.42	968.59	968.76	968.92	969.09	56.00
56.10	969.09	969.26	969.42	969.59	969.76	969.92	970.09	970.26	970.42	970.59	970.76	56.10
56.20	970.76	970.92	971.09	971.26	971.42	971.59	971.76	971.92	972.09	972.26	972.42	56.20
56.30	972.42	972.59	972.76	972.93	973.09	973.26	973.43	973.59	973.76	973.93	974.09	56.30
56.40	974.09	974.26	974.43	974.60	974.76	974.93	975.10	975.26	975.43	975.60	975.76	56.40
56.50	975.76	975.93	976.10	976.27	976.43	976.60	976.77	976.94	977.10	977.27	977.44	56.50
56.60	977.44	977.60	977.77	977.94	978.11	978.27	978.44	978.61	978.78	978.94	979.11	56.60
56.70	979.11	979.28	979.45	979.61	979.78	979.95	980.11	980.28	980.45	980.62	980.78	56.70
56.80	980.78	980.95	981.12	981.29	981.46	981.62	981.79	981.96	982.13	982.29	982.46	56.80
56.90	982.46	982.63	982.80	982.96	983.13	983.30	983.47	983.63	983.80	983.97	984.14	56.90
57.00	984.14	984.31	984.47	984.64	984.81	984.98	985.14	985.31	985.48	985.65	985.82	57.00
57.10	985.82	985.98	986.15	986.32	986.49	986.66	986.82	986.99	987.16	987.33	987.50	57.10
57.20	987.50	987.66	987.83	988.00	988.17	988.34	988.50	988.67	988.84	989.01	989.18	57.20
57.30	989.18	989.35	989.51	989.68	989.85	990.02	990.19	990.35	990.52	990.69	990.86	57.30
57.40	990.86	991.03	991.20	991.36	991.53	991.70	991.87	992.04	992.21	992.37	992.54	57.40
57.50	992.54	992.71	992.88	993.05	993.22	993.39	993.55	993.72	993.89	994.06	994.23	57.50
57.60	994.23	994.40	994.56	994.73	994.90	995.07	995.24	995.41	995.58	995.75	995.91	57.60
57.70	995.91	996.08	996.25	996.42	996.59	996.76	996.93	997.09	997.26	997.43	997.60	57.70
57.80	997.60	997.77	997.94	998.11	998.28	998.44	998.61	998.78	998.95	999.12	999.29	57.80
57.90	999.29	999.46	999.63	999.80	999.96	1000.13	1000.30	1000.47	1000.64	1000.81	1000.98	57.90
58.00	1000.98	1001.15	1001.32	1001.49	1001.65	1001.82	1001.99	1002.16	1002.33	1002.50	1002.67	58.00
58.10	1002.67	1002.84	1003.01	1003.18	1003.35	1003.51	1003.68	1003.85	1004.02	1004.19	1004.36	58.10
58.20	1004.36	1004.53	1004.70	1004.87	1005.04	1005.21	1005.38	1005.55	1005.71	1005.88	1006.05	58.20
58.30	1006.05	1006.22	1006.39	1006.56	1006.73	1006.90	1007.07	1007.24	1007.41	1007.58	1007.75	58.30
58.40	1007.75	1007.92	1008.09	1008.26	1008.43	1008.59	1008.76	1008.93	1009.10	1009.27	1009.44	58.40
58.50	1009.44	1009.61	1009.78	1009.95	1010.12	1010.29	1010.46	1010.63	1010.80	1010.97	1011.14	58.50
58.60	1011.14	1011.31	1011.48	1011.65	1011.82	1011.99	1012.16	1012.33	1012.50	1012.67	1012.84	58.60
58.70	1012.84	1013.01	1013.18	1013.34	1013.51	1013.68	1013.85	1014.02	1014.19	1014.36	1014.53	58.70
58.80	1014.53	1014.70	1014.87	1015.04	1015.21	1015.38	1015.55	1015.72	1015.89	1016.06	1016.23	58.80
58.90	1016.23	1016.40	1016.57	1016.74	1016.91	1017.08	1017.25	1017.42	1017.59	1017.76	1017.93	58.90
59.00	1017.93	1018.10	1018.27	1018.44	1018.61	1018.78	1018.95	1019.12	1019.29	1019.46	1019.63	59.00
59.10	1019.63	1019.80	1019.97	1020.14	1020.32	1020.49	1020.66	1020.83	1021.00	1021.17	1021.34	59.10
59.20	1021.34	1021.51	1021.68	1021.85	1022.02	1022.19	1022.36	1022.53	1022.70	1022.87	1023.04	59.20
59.30	1023.04	1023.21	1023.38	1023.55	1023.72	1023.89	1024.06	1024.23	1024.40	1024.57	1024.74	59.30
59.40	1024.74	1024.91	1025.08	1025.25	1025.43	1025.60	1025.77	1025.94	1026.11	1026.28	1026.45	59.40
59.50	1026.45	1026.62	1026.79	1026.96	1027.13	1027.30	1027.47	1027.64	1027.81	1027.98	1028.15	59.50
59.60	1028.15	1028.32	1028.50	1028.67	1028.84	1029.01	1029.18	1029.35	1029.52	1029.69	1029.86	59.60
59.70	1029.86	1030.03	1030.20	1030.37	1030.54	1030.71	1030.89	1031.06	1031.23	1031.40	1031.57	59.70
59.80	1031.57	1031.74	1031.91	1032.08	1032.25	1032.42	1032.59	1032.76	1032.94	1033.11	1033.28	59.80
59.90	1033.28	1033.45	1033.62	1033.79	1033.96	1034.13	1034.30	1034.47	1034.64	1034.82	1034.99	59.90
60.00	1034.99	1035.16	1035.33	1035.50	1035.67	1035.84	1036.01	1036.18	1036.35	1036.53	1036.70	60.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.1. *Type J thermocouples extended range—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (1PTS 1968)												
60.00	1034.99	1035.16	1035.33	1035.50	1035.67	1035.84	1036.01	1036.18	1036.35	1036.53	1036.70	60.00
60.10	1036.70	1036.87	1037.04	1037.21	1037.38	1037.55	1037.72	1037.89	1038.06	1038.24	1038.41	60.10
60.20	1038.41	1038.58	1038.75	1038.92	1039.09	1039.26	1039.43	1039.61	1039.78	1039.95	1040.12	60.20
60.30	1040.12	1040.29	1040.46	1040.63	1040.80	1040.97	1041.15	1041.32	1041.49	1041.66	1041.83	60.30
60.40	1041.83	1042.00	1042.17	1042.35	1042.52	1042.69	1042.86	1043.03	1043.20	1043.37	1043.54	60.40
60.50	1043.54	1043.72	1043.89	1044.06	1044.23	1044.40	1044.57	1044.74	1044.92	1045.09	1045.26	60.50
60.60	1045.26	1045.43	1045.60	1045.77	1045.94	1046.12	1046.29	1046.46	1046.63	1046.80	1046.97	60.60
60.70	1046.97	1047.14	1047.32	1047.49	1047.66	1047.83	1048.00	1048.17	1048.35	1048.52	1048.69	60.70
60.80	1048.69	1048.86	1049.03	1049.20	1049.37	1049.55	1049.72	1049.89	1050.06	1050.23	1050.40	60.80
60.90	1050.40	1050.58	1050.75	1050.92	1051.09	1051.26	1051.43	1051.61	1051.78	1051.95	1052.12	60.90
61.00	1052.12	1052.29	1052.46	1052.64	1052.81	1052.98	1053.15	1053.32	1053.49	1053.67	1053.84	61.00
61.10	1053.84	1054.01	1054.18	1054.35	1054.53	1054.70	1054.87	1055.04	1055.21	1055.38	1055.56	61.10
61.20	1055.56	1055.73	1055.90	1056.07	1056.24	1056.42	1056.59	1056.76	1056.93	1057.10	1057.27	61.20
61.30	1057.27	1057.45	1057.62	1057.79	1057.96	1058.13	1058.31	1058.48	1058.65	1058.82	1058.99	61.30
61.40	1058.99	1059.17	1059.34	1059.51	1059.68	1059.85	1060.03	1060.20	1060.37	1060.54	1060.71	61.40
61.50	1060.71	1060.89	1061.06	1061.23	1061.40	1061.57	1061.75	1061.92	1062.09	1062.26	1062.43	61.50
61.60	1062.43	1062.61	1062.78	1062.95	1063.12	1063.29	1063.47	1063.64	1063.81	1063.98	1064.15	61.60
61.70	1064.15	1064.33	1064.50	1064.67	1064.84	1065.02	1065.19	1065.36	1065.53	1065.70	1065.88	61.70
61.80	1065.88	1066.05	1066.22	1066.39	1066.56	1066.74	1066.91	1067.08	1067.25	1067.43	1067.60	61.80
61.90	1067.60	1067.77	1067.94	1068.11	1068.29	1068.46	1068.63	1068.80	1068.98	1069.15	1069.32	61.90
62.00	1069.32	1069.49	1069.66	1069.84	1070.01	1070.18	1070.35	1070.53	1070.70	1070.87	1071.04	62.00
62.10	1071.04	1071.22	1071.39	1071.56	1071.73	1071.90	1072.08	1072.25	1072.42	1072.59	1072.77	62.10
62.20	1072.77	1072.94	1073.11	1073.28	1073.46	1073.63	1073.80	1073.97	1074.15	1074.32	1074.49	62.20
62.30	1074.49	1074.66	1074.84	1075.01	1075.18	1075.35	1075.52	1075.70	1075.87	1076.04	1076.21	62.30
62.40	1076.21	1076.39	1076.56	1076.73	1076.90	1077.08	1077.25	1077.42	1077.59	1077.77	1077.94	62.40
62.50	1077.94	1078.11	1078.28	1078.46	1078.63	1078.80	1078.97	1079.15	1079.32	1079.49	1079.66	62.50
62.60	1079.66	1079.84	1080.01	1080.18	1080.35	1080.53	1080.70	1080.87	1081.04	1081.22	1081.39	62.60
62.70	1081.39	1081.56	1081.73	1081.91	1082.08	1082.25	1082.43	1082.60	1082.77	1082.94	1083.12	62.70
62.80	1083.12	1083.29	1083.46	1083.63	1083.81	1083.98	1084.15	1084.32	1084.50	1084.67	1084.84	62.80
62.90	1084.84	1085.01	1085.19	1085.36	1085.53	1085.71	1085.88	1086.05	1086.22	1086.40	1086.57	62.90
63.00	1086.57	1086.74	1086.91	1087.09	1087.26	1087.43	1087.60	1087.78	1087.95	1088.12	1088.30	63.00
63.10	1088.30	1088.47	1088.64	1088.81	1088.99	1089.16	1089.33	1089.50	1089.68	1089.85	1090.02	63.10
63.20	1090.02	1090.20	1090.37	1090.54	1090.71	1090.89	1091.06	1091.23	1091.40	1091.58	1091.75	63.20
63.30	1091.75	1091.92	1092.10	1092.27	1092.44	1092.61	1092.79	1092.96	1093.13	1093.31	1093.48	63.30
63.40	1093.48	1093.65	1093.82	1094.00	1094.17	1094.34	1094.52	1094.69	1094.86	1095.03	1095.21	63.40
63.50	1095.21	1095.38	1095.55	1095.72	1095.90	1096.07	1096.24	1096.42	1096.59	1096.76	1096.93	63.50
63.60	1096.93	1097.11	1097.28	1097.45	1097.63	1097.80	1097.97	1098.15	1098.32	1098.49	1098.66	63.60
63.70	1098.66	1098.84	1099.01	1099.18	1099.36	1099.53	1099.70	1099.87	1100.05	1100.22	1100.39	63.70
63.80	1100.39	1100.57	1100.74	1100.91	1101.08	1101.26	1101.43	1101.60	1101.78	1101.95	1102.12	63.80
63.90	1102.12	1102.30	1102.47	1102.64	1102.81	1102.99	1103.16	1103.33	1103.51	1103.68	1103.85	63.90
64.00	1103.85	1104.02	1104.20	1104.37	1104.54	1104.72	1104.89	1105.06	1105.24	1105.41	1105.58	64.00
64.10	1105.58	1105.75	1105.93	1106.10	1106.27	1106.45	1106.62	1106.79	1106.97	1107.14	1107.31	64.10
64.20	1107.31	1107.48	1107.66	1107.83	1108.00	1108.18	1108.35	1108.52	1108.70	1108.87	1109.04	64.20
64.30	1109.04	1109.22	1109.39	1109.56	1109.73	1109.91	1110.08	1110.25	1110.43	1110.60	1110.77	64.30
64.40	1110.77	1110.95	1111.12	1111.29	1111.47	1111.64	1111.81	1111.98	1112.16	1112.33	1112.50	64.40
64.50	1112.50	1112.68	1112.85	1113.02	1113.20	1113.37	1113.54	1113.72	1113.89	1114.06	1114.23	64.50
64.60	1114.23	1114.41	1114.58	1114.75	1114.93	1115.10	1115.27	1115.45	1115.62	1115.79	1115.97	64.60
64.70	1115.97	1116.14	1116.31	1116.49	1116.66	1116.83	1117.00	1117.18	1117.35	1117.52	1117.70	64.70
64.80	1117.70	1117.87	1118.04	1118.22	1118.39	1118.56	1118.74	1118.91	1119.08	1119.26	1119.43	64.80
64.90	1119.43	1119.60	1119.78	1119.95	1120.12	1120.29	1120.47	1120.64	1120.81	1120.99	1121.16	64.90
65.00	1121.16	1121.33	1121.51	1121.68	1121.85	1122.03	1122.20	1122.37	1122.55	1122.72	1122.89	65.00
65.10	1122.89	1123.07	1123.24	1123.41	1123.59	1123.76	1123.93	1124.11	1124.28	1124.45	1124.62	65.10
65.20	1124.62	1124.80	1124.97	1125.14	1125.32	1125.49	1125.66	1125.84	1126.01	1126.18	1126.36	65.20
65.30	1126.36	1126.53	1126.70	1126.88	1127.05	1127.22	1127.40	1127.57	1127.74	1127.92	1128.09	65.30
65.40	1128.09	1128.26	1128.44	1128.61	1128.78	1128.96	1129.13	1129.30	1129.48	1129.65	1129.82	65.40
65.50	1129.82	1130.00	1130.17	1130.34	1130.52	1130.69	1130.86	1131.04	1131.21	1131.38	1131.56	65.50
65.60	1131.56	1131.73	1131.90	1132.08	1132.25	1132.42	1132.60	1132.77	1132.94	1133.12	1133.29	65.60
65.70	1133.29	1133.46	1133.64	1133.81	1133.98	1134.16	1134.33	1134.50	1134.68	1134.85	1135.02	65.70
65.80	1135.02	1135.20	1135.37	1135.54	1135.72	1135.89	1136.06	1136.24	1136.41	1136.58	1136.76	65.80
65.90	1136.76	1136.93	1137.10	1137.28	1137.45	1137.62	1137.80	1137.97	1138.14	1138.32	1138.49	65.90
66.00	1138.49	1138.66	1138.84	1139.01	1139.18	1139.36	1139.53	1139.70	1139.88	1140.05	1140.22	66.00

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
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TABLE A6.2.1. *Type J thermocouples extended range—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
66.00	1138.49	1138.66	1138.84	1139.01	1139.18	1139.36	1139.53	1139.70	1139.88	1140.05	1140.22	66.00
66.10	1140.22	1140.40	1140.57	1140.74	1140.92	1141.09	1141.26	1141.44	1141.61	1141.78	1141.96	66.10
66.20	1141.96	1142.13	1142.30	1142.48	1142.65	1142.82	1143.00	1143.17	1143.34	1143.52	1143.69	66.20
66.30	1143.69	1143.87	1144.04	1144.21	1144.39	1144.56	1144.73	1144.91	1145.08	1145.25	1145.43	66.30
66.40	1145.43	1145.60	1145.77	1145.95	1146.12	1146.29	1146.47	1146.64	1146.81	1146.99	1147.16	66.40
66.50	1147.16	1147.33	1147.51	1147.68	1147.86	1148.03	1148.20	1148.38	1148.55	1148.72	1148.90	66.50
66.60	1148.90	1149.07	1149.24	1149.42	1149.59	1149.76	1149.94	1150.11	1150.28	1150.46	1150.63	66.60
66.70	1150.63	1150.80	1150.98	1151.15	1151.33	1151.50	1151.67	1151.85	1152.02	1152.19	1152.37	66.70
66.80	1152.37	1152.54	1152.71	1152.89	1153.06	1153.23	1153.41	1153.58	1153.76	1153.93	1154.10	66.80
66.90	1154.10	1154.28	1154.45	1154.62	1154.80	1154.97	1155.14	1155.32	1155.49	1155.66	1155.84	66.90
67.00	1155.84	1156.01	1156.19	1156.36	1156.53	1156.71	1156.88	1157.05	1157.23	1157.40	1157.57	67.00
67.10	1157.57	1157.75	1157.92	1158.10	1158.27	1158.44	1158.62	1158.79	1158.96	1159.14	1159.31	67.10
67.20	1159.31	1159.49	1159.66	1159.83	1160.01	1160.18	1160.35	1160.53	1160.70	1160.87	1161.05	67.20
67.30	1161.05	1161.22	1161.40	1161.57	1161.74	1161.92	1162.09	1162.26	1162.44	1162.61	1162.79	67.30
67.40	1162.79	1162.96	1163.13	1163.31	1163.48	1163.65	1163.83	1164.00	1164.18	1164.35	1164.52	67.40
67.50	1164.52	1164.70	1164.87	1165.04	1165.22	1165.39	1165.57	1165.74	1165.91	1166.09	1166.26	67.50
67.60	1166.26	1166.43	1166.61	1166.78	1166.96	1167.13	1167.30	1167.48	1167.65	1167.82	1168.00	67.60
67.70	1168.00	1168.17	1168.35	1168.52	1168.69	1168.87	1169.04	1169.22	1169.39	1169.56	1169.74	67.70
67.80	1169.74	1169.91	1170.09	1170.26	1170.43	1170.61	1170.78	1170.95	1171.13	1171.30	1171.48	67.80
67.90	1171.48	1171.65	1171.82	1172.00	1172.17	1172.35	1172.52	1172.69	1172.87	1173.04	1173.22	67.90
68.00	1173.22	1173.39	1173.56	1173.74	1173.91	1174.09	1174.26	1174.43	1174.61	1174.78	1174.96	68.00
68.10	1174.96	1175.13	1175.30	1175.48	1175.65	1175.83	1176.00	1176.17	1176.35	1176.52	1176.70	68.10
68.20	1176.70	1176.87	1177.04	1177.22	1177.39	1177.57	1177.74	1177.91	1178.09	1178.26	1178.44	68.20
68.30	1178.44	1178.61	1178.78	1178.96	1179.13	1179.31	1179.48	1179.66	1179.83	1180.00	1180.18	68.30
68.40	1180.18	1180.35	1180.53	1180.70	1180.87	1181.05	1181.22	1181.40	1181.57	1181.74	1181.92	68.40
68.50	1181.92	1182.09	1182.27	1182.44	1182.62	1182.79	1182.96	1183.14	1183.31	1183.49	1183.66	68.50
68.60	1183.66	1183.84	1184.01	1184.18	1184.36	1184.53	1184.71	1184.88	1185.06	1185.23	1185.40	68.60
68.70	1185.40	1185.58	1185.75	1185.93	1186.10	1186.28	1186.45	1186.62	1186.80	1186.97	1187.15	68.70
68.80	1187.15	1187.32	1187.50	1187.67	1187.85	1188.02	1188.19	1188.37	1188.54	1188.72	1188.89	68.80
68.90	1188.89	1189.07	1189.24	1189.41	1189.59	1189.76	1189.94	1190.11	1190.29	1190.46	1190.64	68.90
69.00	1190.64	1190.81	1190.99	1191.16	1191.33	1191.51	1191.68	1191.86	1192.03	1192.21	1192.38	69.00
69.10	1192.38	1192.56	1192.73	1192.91	1193.08	1193.25	1193.43	1193.60	1193.78	1193.95	1194.13	69.10
69.20	1194.13	1194.30	1194.48	1194.65	1194.83	1195.00	1195.18	1195.35	1195.52	1195.70	1195.87	69.20
69.30	1195.87	1196.05	1196.22	1196.40	1196.57	1196.75	1196.92	1197.10	1197.27	1197.45	1197.62	69.30
69.40	1197.62	1197.80	1197.97	1198.15	1198.32	1198.50	1198.67	1198.85	1199.02	1199.20	1199.37	69.40
69.50	1199.37	1199.55	1199.72	1199.89								69.50
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
-8.00	-337.31	-338.19	-339.08	-339.97	-340.87	-341.78	-342.69	-343.61	-344.54	-345.47		-8.00
-7.90	-328.79	-329.62	-330.45	-331.29	-332.13	-332.98	-333.84	-334.70	-335.56	-336.43	-337.31	-7.90
-7.80	-320.73	-321.52	-322.31	-323.10	-323.90	-324.71	-325.51	-326.33	-327.14	-327.96	-328.79	-7.80
-7.70	-313.06	-313.82	-314.57	-315.33	-316.09	-316.85	-317.62	-318.39	-319.17	-319.95	-320.73	-7.70
-7.60	-305.72	-306.45	-307.17	-307.90	-308.62	-309.36	-310.09	-310.83	-311.57	-312.32	-313.06	-7.60
-7.50	-298.67	-299.36	-300.06	-300.76	-301.46	-302.16	-302.87	-303.58	-304.29	-305.01	-305.72	-7.50
-7.40	-291.85	-292.52	-293.20	-293.87	-294.55	-295.23	-295.91	-296.60	-297.29	-297.97	-298.67	-7.40
-7.30	-285.26	-285.91	-286.56	-287.21	-287.87	-288.53	-289.19	-289.85	-290.52	-291.18	-291.85	-7.30
-7.20	-278.85	-279.48	-280.12	-280.75	-281.39	-282.03	-282.67	-283.31	-283.96	-284.61	-285.26	-7.20
-7.10	-272.62	-273.23	-273.85	-274.47	-275.09	-275.71	-276.34	-276.96	-277.59	-278.22	-278.85	-7.10
-7.00	-266.54	-267.14	-267.74	-268.35	-268.95	-269.56	-270.17	-270.78	-271.39	-272.00	-272.62	-7.00
-6.90	-260.60	-261.19	-261.78	-262.37	-262.96	-263.55	-264.15	-264.74	-265.34	-265.94	-266.54	-6.90
-6.80	-254.79	-255.37	-255.94	-256.52	-257.10	-257.68	-258.26	-258.84	-259.43	-260.01	-260.60	-6.80
-6.70	-249.10	-249.66	-250.23	-250.80	-251.36	-251.93	-252.50	-253.07	-253.64	-254.22	-254.79	-6.70
-6.60	-243.52	-244.07	-244.63	-245.18	-245.74	-246.30	-246.85	-247.41	-247.97	-248.54	-249.10	-6.60
-6.50	-238.04	-238.58	-239.13	-239.67	-240.22	-240.77	-241.31	-241.86	-242.41	-242.97	-243.52	-6.50
-6.40	-232.65	-233.18	-233.72	-234.26	-234.79	-235.33	-235.87	-236.41	-236.95	-237.49	-238.04	-6.40
-6.30	-227.35	-227.87	-228.40	-228.93	-229.46	-229.99	-230.52	-231.05	-231.58	-232.12	-232.65	-6.30
-6.20	-222.13	-222.65	-223.17	-223.69	-224.21	-224.73	-225.25	-225.77	-226.30	-226.82	-227.35	-6.20
-6.10	-216.99	-217.50	-218.01	-218.52	-219.03	-219.55	-220.06	-220.58	-221.09	-221.61	-222.13	-6.10
-6.00	-211.92	-212.42	-212.92	-213.43	-213.94	-214.44	-214.95	-215.46	-215.97	-216.48	-216.99	-6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
-6.00	-211.92	-212.42	-212.92	-213.43	-213.94	-214.44	-214.95	-215.46	-215.97	-216.48	-216.99	-6.00
-5.90	-206.91	-207.41	-207.91	-208.41	-208.90	-209.40	-209.91	-210.41	-210.91	-211.41	-211.92	-5.90
-5.80	-201.97	-202.46	-202.95	-203.45	-203.94	-204.43	-204.93	-205.42	-205.92	-206.41	-206.91	-5.80
-5.70	-197.09	-197.57	-198.06	-198.55	-199.03	-199.52	-200.01	-200.50	-200.99	-201.48	-201.97	-5.70
-5.60	-192.27	-192.75	-193.23	-193.71	-194.19	-194.67	-195.15	-195.64	-196.12	-196.60	-197.09	-5.60
-5.50	-187.50	-187.97	-188.45	-188.92	-189.40	-189.87	-190.35	-190.83	-191.31	-191.79	-192.27	-5.50
-5.40	-182.78	-183.25	-183.72	-184.19	-184.66	-185.13	-185.60	-186.07	-186.55	-187.02	-187.50	-5.40
-5.30	-178.11	-178.57	-179.04	-179.50	-179.97	-180.43	-180.90	-181.37	-181.84	-182.31	-182.78	-5.30
-5.20	-173.48	-173.94	-174.40	-174.86	-175.33	-175.79	-176.25	-176.71	-177.18	-177.64	-178.11	-5.20
-5.10	-168.90	-169.36	-169.81	-170.27	-170.73	-171.19	-171.64	-172.10	-172.56	-173.02	-173.48	-5.10
-5.00	-164.36	-164.81	-165.27	-165.72	-166.17	-166.63	-167.08	-167.54	-167.99	-168.45	-168.90	-5.00
-4.90	-159.86	-160.31	-160.76	-161.21	-161.66	-162.11	-162.56	-163.01	-163.46	-163.91	-164.36	-4.90
-4.80	-155.41	-155.85	-156.29	-156.74	-157.18	-157.63	-158.08	-158.52	-158.97	-159.42	-159.86	-4.80
-4.70	-150.98	-151.42	-151.86	-152.31	-152.75	-153.19	-153.63	-154.07	-154.52	-154.96	-155.41	-4.70
-4.60	-146.60	-147.03	-147.47	-147.91	-148.35	-148.78	-149.22	-149.66	-150.10	-150.54	-150.98	-4.60
-4.50	-142.24	-142.68	-143.11	-143.54	-143.98	-144.41	-144.85	-145.29	-145.72	-146.16	-146.60	-4.50
-4.40	-137.92	-138.35	-138.78	-139.21	-139.65	-140.08	-140.51	-140.94	-141.38	-141.81	-142.24	-4.40
-4.30	-133.63	-134.06	-134.49	-134.92	-135.34	-135.77	-136.20	-136.63	-137.06	-137.49	-137.92	-4.30
-4.20	-129.37	-129.80	-130.22	-130.65	-131.07	-131.50	-131.92	-132.35	-132.78	-133.20	-133.63	-4.20
-4.10	-125.14	-125.56	-125.99	-126.41	-126.83	-127.25	-127.68	-128.10	-128.52	-128.95	-129.37	-4.10
-4.00	-120.94	-121.36	-121.78	-122.20	-122.62	-123.04	-123.46	-123.88	-124.30	-124.72	-125.14	-4.00
-3.90	-116.76	-117.18	-117.60	-118.01	-118.43	-118.85	-119.27	-119.68	-120.10	-120.52	-120.94	-3.90
-3.80	-112.61	-113.03	-113.44	-113.86	-114.27	-114.69	-115.10	-115.52	-115.93	-116.35	-116.76	-3.80
-3.70	-108.49	-108.90	-109.31	-109.72	-110.14	-110.55	-110.96	-111.37	-111.79	-112.20	-112.61	-3.70
-3.60	-104.39	-104.80	-105.21	-105.62	-106.03	-106.44	-106.85	-107.26	-107.67	-108.08	-108.49	-3.60
-3.50	-100.31	-100.72	-101.12	-101.53	-101.94	-102.35	-102.75	-103.16	-103.57	-103.98	-104.39	-3.50
-3.40	-96.26	-96.66	-97.07	-97.47	-97.88	-98.28	-98.69	-99.09	-99.50	-99.90	-100.31	-3.40
-3.30	-92.22	-92.63	-93.03	-93.43	-93.83	-94.24	-94.64	-95.04	-95.45	-95.85	-96.26	-3.30
-3.20	-88.21	-88.61	-89.01	-89.41	-89.81	-90.22	-90.62	-91.02	-91.42	-91.82	-92.22	-3.20
-3.10	-84.22	-84.62	-85.02	-85.42	-85.82	-86.21	-86.61	-87.01	-87.41	-87.81	-88.21	-3.10
-3.00	-80.25	-80.65	-81.04	-81.44	-81.84	-82.23	-82.63	-83.03	-83.43	-83.82	-84.22	-3.00
-2.90	-76.30	-76.69	-77.09	-77.48	-77.88	-78.27	-78.67	-79.06	-79.46	-79.85	-80.25	-2.90
-2.80	-72.36	-72.76	-73.15	-73.54	-73.94	-74.33	-74.72	-75.12	-75.51	-75.90	-76.30	-2.80
-2.70	-68.45	-68.84	-69.23	-69.62	-70.01	-70.40	-70.80	-71.19	-71.58	-71.97	-72.36	-2.70
-2.60	-64.55	-64.94	-65.33	-65.72	-66.11	-66.50	-66.89	-67.28	-67.67	-68.06	-68.45	-2.60
-2.50	-60.67	-61.06	-61.44	-61.83	-62.22	-62.61	-63.00	-63.38	-63.77	-64.16	-64.55	-2.50
-2.40	-56.80	-57.19	-57.58	-57.96	-58.35	-58.73	-59.12	-59.51	-59.90	-60.28	-60.67	-2.40
-2.30	-52.96	-53.34	-53.72	-54.11	-54.49	-54.88	-55.26	-55.65	-56.03	-56.42	-56.80	-2.30
-2.20	-49.12	-49.51	-49.89	-50.27	-50.65	-51.04	-51.42	-51.80	-52.19	-52.57	-52.96	-2.20
-2.10	-45.31	-45.69	-46.07	-46.45	-46.83	-47.21	-47.59	-47.98	-48.36	-48.74	-49.12	-2.10
-2.00	-41.50	-41.88	-42.26	-42.64	-43.02	-43.40	-43.78	-44.16	-44.54	-44.92	-45.31	-2.00
-1.90	-37.71	-38.09	-38.47	-38.85	-39.23	-39.61	-39.99	-40.36	-40.74	-41.12	-41.50	-1.90
-1.80	-33.94	-34.32	-34.69	-35.07	-35.45	-35.82	-36.20	-36.58	-36.96	-37.34	-37.71	-1.80
-1.70	-30.18	-30.55	-30.93	-31.30	-31.68	-32.06	-32.43	-32.81	-33.19	-33.56	-33.94	-1.70
-1.60	-26.43	-26.80	-27.18	-27.55	-27.93	-28.30	-28.68	-29.05	-29.43	-29.80	-30.18	-1.60
-1.50	-22.69	-23.07	-23.44	-23.81	-24.19	-24.56	-24.93	-25.31	-25.68	-26.06	-26.43	-1.50
-1.40	-18.97	-19.34	-19.72	-20.09	-20.46	-20.83	-21.20	-21.58	-21.95	-22.32	-22.69	-1.40
-1.30	-15.26	-15.63	-16.00	-16.37	-16.74	-17.11	-17.49	-17.86	-18.23	-18.60	-18.97	-1.30
-1.20	-11.56	-11.93	-12.30	-12.67	-13.04	-13.41	-13.78	-14.15	-14.52	-14.89	-15.26	-1.20
-1.10	-7.87	-8.24	-8.61	-8.98	-9.35	-9.72	-10.09	-10.45	-10.82	-11.19	-11.56	-1.10
-1.00	-4.20	-4.57	-4.93	-5.30	-5.67	-6.04	-6.40	-6.77	-7.14	-7.51	-7.87	-1.00
-0.90	-0.53	-0.90	-1.27	-1.63	-2.00	-2.37	-2.73	-3.10	-3.47	-3.83	-4.20	-0.90
-0.80	3.12	2.76	2.39	2.03	1.66	1.29	0.93	0.56	0.20	-0.17	-0.53	-0.80
-0.70	6.76	6.40	6.04	5.67	5.31	4.94	4.58	4.21	3.85	3.49	3.12	-0.70
-0.60	10.40	10.03	9.67	9.31	8.95	8.58	8.22	7.86	7.49	7.13	6.76	-0.60
-0.50	14.02	13.66	13.30	12.94	12.57	12.21	11.85	11.49	11.12	10.76	10.40	-0.50
-0.40	17.64	17.27	16.91	16.55	16.19	15.83	15.47	15.11	14.75	14.38	14.02	-0.40
-0.30	21.24	20.88	20.52	20.16	19.80	19.44	19.08	18.72	18.36	18.00	17.64	-0.30
-0.20	24.84	24.48	24.12	23.76	23.40	23.04	22.68	22.32	21.96	21.60	21.24	-0.20
-0.10	28.42	28.06	27.71	27.35	26.99	26.63	26.27	25.91	25.55	25.19	24.84	-0.10
-0.00	32.00	31.64	31.29	30.93	30.57	30.21	29.85	29.50	29.14	28.78	28.42	-0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. Type J thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
0.00	32.00	32.36	32.71	33.07	33.43	33.79	34.14	34.50	34.86	35.21	35.57	0.00
0.10	35.57	35.93	36.28	36.64	36.99	37.35	37.71	38.06	38.42	38.77	39.13	0.10
0.20	39.13	39.49	39.84	40.20	40.55	40.91	41.26	41.62	41.97	42.33	42.68	0.20
0.30	42.68	43.04	43.39	43.75	44.10	44.46	44.81	45.16	45.52	45.87	46.23	0.30
0.40	46.23	46.58	46.93	47.29	47.64	48.00	48.35	48.70	49.06	49.41	49.76	0.40
0.50	49.76	50.12	50.47	50.82	51.18	51.53	51.88	52.24	52.59	52.94	53.29	0.50
0.60	53.29	53.65	54.00	54.35	54.70	55.05	55.41	55.76	56.11	56.46	56.81	0.60
0.70	56.81	57.17	57.52	57.87	58.22	58.57	58.92	59.28	59.63	59.98	60.33	0.70
0.80	60.33	60.68	61.03	61.38	61.73	62.08	62.43	62.79	63.14	63.49	63.84	0.80
0.90	63.84	64.19	64.54	64.89	65.24	65.59	65.94	66.29	66.64	66.99	67.34	0.90
1.00	67.34	67.69	68.04	68.39	68.74	69.08	69.43	69.78	70.13	70.48	70.83	1.00
1.10	70.83	71.18	71.53	71.88	72.23	72.58	72.92	73.27	73.62	73.97	74.32	1.10
1.20	74.32	74.67	75.01	75.36	75.71	76.06	76.41	76.75	77.10	77.45	77.80	1.20
1.30	77.80	78.15	78.49	78.84	79.19	79.54	79.88	80.23	80.58	80.93	81.27	1.30
1.40	81.27	81.62	81.97	82.31	82.66	83.01	83.35	83.70	84.05	84.39	84.74	1.40
1.50	84.74	85.09	85.43	85.78	86.13	86.47	86.82	87.16	87.51	87.86	88.20	1.50
1.60	88.20	88.55	88.89	89.24	89.59	89.93	90.28	90.62	90.97	91.31	91.66	1.60
1.70	91.66	92.00	92.35	92.69	93.04	93.38	93.73	94.07	94.42	94.76	95.11	1.70
1.80	95.11	95.45	95.80	96.14	96.49	96.83	97.18	97.52	97.87	98.21	98.55	1.80
1.90	98.55	98.90	99.24	99.59	99.93	100.27	100.62	100.96	101.31	101.65	101.99	1.90
2.00	101.99	102.34	102.68	103.02	103.37	103.71	104.05	104.40	104.74	105.08	105.43	2.00
2.10	105.43	105.77	106.11	106.46	106.80	107.14	107.48	107.83	108.17	108.51	108.86	2.10
2.20	108.86	109.20	109.54	109.88	110.23	110.57	110.91	111.25	111.59	111.94	112.28	2.20
2.30	112.28	112.62	112.96	113.30	113.65	113.99	114.33	114.67	115.01	115.36	115.70	2.30
2.40	115.70	116.04	116.38	116.72	117.06	117.40	117.75	118.09	118.43	118.77	119.11	2.40
2.50	119.11	119.45	119.79	120.13	120.47	120.81	121.16	121.50	121.84	122.18	122.52	2.50
2.60	122.52	122.86	123.20	123.54	123.88	124.22	124.56	124.90	125.24	125.58	125.92	2.60
2.70	125.92	126.26	126.60	126.94	127.28	127.62	127.96	128.30	128.64	128.98	129.32	2.70
2.80	129.32	129.66	130.00	130.34	130.68	131.02	131.36	131.70	132.04	132.38	132.72	2.80
2.90	132.72	133.06	133.39	133.73	134.07	134.41	134.75	135.09	135.43	135.77	136.11	2.90
3.00	136.11	136.45	136.78	137.12	137.46	137.80	138.14	138.48	138.82	139.15	139.49	3.00
3.10	139.49	139.83	140.17	140.51	140.85	141.18	141.52	141.86	142.20	142.54	142.87	3.10
3.20	142.87	143.21	143.55	143.89	144.23	144.56	144.90	145.24	145.58	145.91	146.25	3.20
3.30	146.25	146.59	146.93	147.26	147.60	147.94	148.28	148.61	148.95	149.29	149.63	3.30
3.40	149.63	149.96	150.30	150.64	150.97	151.31	151.65	151.98	152.32	152.66	153.00	3.40
3.50	153.00	153.33	153.67	154.01	154.34	154.68	155.02	155.35	155.69	156.02	156.36	3.50
3.60	156.36	156.70	157.03	157.37	157.71	158.04	158.38	158.71	159.05	159.39	159.72	3.60
3.70	159.72	160.06	160.40	160.73	161.07	161.40	161.74	162.07	162.41	162.75	163.08	3.70
3.80	163.08	163.42	163.75	164.09	164.42	164.76	165.09	165.43	165.77	166.10	166.44	3.80
3.90	166.44	166.77	167.11	167.44	167.78	168.11	168.45	168.78	169.12	169.45	169.79	3.90
4.00	169.79	170.12	170.46	170.79	171.13	171.46	171.80	172.13	172.47	172.80	173.14	4.00
4.10	173.14	173.47	173.80	174.14	174.47	174.81	175.14	175.48	175.81	176.15	176.48	4.10
4.20	176.48	176.81	177.15	177.48	177.82	178.15	178.49	178.82	179.15	179.49	179.82	4.20
4.30	179.82	180.16	180.49	180.82	181.16	181.49	181.82	182.16	182.49	182.83	183.16	4.30
4.40	183.16	183.49	183.83	184.16	184.49	184.83	185.16	185.49	185.83	186.16	186.49	4.40
4.50	186.49	186.83	187.16	187.49	187.83	188.16	188.49	188.83	189.16	189.49	189.83	4.50
4.60	189.83	190.16	190.49	190.83	191.16	191.49	191.82	192.16	192.49	192.82	193.16	4.60
4.70	193.16	193.49	193.82	194.15	194.49	194.82	195.15	195.48	195.82	196.15	196.48	4.70
4.80	196.48	196.81	197.15	197.48	197.81	198.14	198.48	198.81	199.14	199.47	199.80	4.80
4.90	199.80	200.14	200.47	200.80	201.13	201.46	201.80	202.13	202.46	202.79	203.12	4.90
5.00	203.12	203.46	203.79	204.12	204.45	204.78	205.12	205.45	205.78	206.11	206.44	5.00
5.10	206.44	206.77	207.11	207.44	207.77	208.10	208.43	208.76	209.09	209.43	209.76	5.10
5.20	209.76	210.09	210.42	210.75	211.08	211.41	211.75	212.08	212.41	212.74	213.07	5.20
5.30	213.07	213.40	213.73	214.06	214.39	214.73	215.06	215.39	215.72	216.05	216.38	5.30
5.40	216.38	216.71	217.04	217.37	217.70	218.03	218.36	218.70	219.03	219.36	219.69	5.40
5.50	219.69	220.02	220.35	220.68	221.01	221.34	221.67	222.00	222.33	222.66	222.99	5.50
5.60	222.99	223.32	223.65	223.98	224.31	224.64	224.97	225.30	225.63	225.97	226.30	5.60
5.70	226.30	226.63	226.96	227.29	227.62	227.95	228.28	228.61	228.94	229.27	229.60	5.70
5.80	229.60	229.93	230.26	230.59	230.92	231.25	231.57	231.90	232.23	232.56	232.89	5.80
5.90	232.89	233.22	233.55	233.88	234.21	234.54	234.87	235.20	235.53	235.86	236.19	5.90
6.00	236.19	236.52	236.85	237.18	237.51	237.84	238.17	238.50	238.83	239.15	239.48	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
6.00	236.19	236.52	236.85	237.18	237.51	237.84	238.17	238.50	238.83	239.15	239.48	6.00
6.10	239.48	239.81	240.14	240.47	240.80	241.13	241.46	241.79	242.12	242.45	242.78	6.10
6.20	242.78	243.11	243.43	243.76	244.09	244.42	244.75	245.08	245.41	245.74	246.07	6.20
6.30	246.07	246.39	246.72	247.05	247.38	247.71	248.04	248.37	248.70	249.03	249.35	6.30
6.40	249.35	249.68	250.01	250.34	250.67	251.00	251.33	251.65	251.98	252.31	252.64	6.40
6.50	252.64	252.97	253.30	253.63	253.95	254.28	254.61	254.94	255.27	255.60	255.92	6.50
6.60	255.92	256.25	256.58	256.91	257.24	257.57	257.89	258.22	258.55	258.88	259.21	6.60
6.70	259.21	259.54	259.86	260.19	260.52	260.85	261.18	261.50	261.83	262.16	262.49	6.70
6.80	262.49	262.82	263.14	263.47	263.80	264.13	264.46	264.78	265.11	265.44	265.77	6.80
6.90	265.77	266.09	266.42	266.75	267.08	267.41	267.73	268.06	268.39	268.72	269.04	6.90
7.00	269.04	269.37	269.70	270.03	270.35	270.68	271.01	271.34	271.66	271.99	272.32	7.00
7.10	272.32	272.65	272.97	273.30	273.63	273.96	274.28	274.61	274.94	275.27	275.59	7.10
7.20	275.59	275.92	276.25	276.58	276.90	277.23	277.56	277.89	278.21	278.54	278.87	7.20
7.30	278.87	279.19	279.52	279.85	280.18	280.50	280.83	281.16	281.48	281.81	282.14	7.30
7.40	282.14	282.47	282.79	283.12	283.45	283.77	284.10	284.43	284.75	285.08	285.41	7.40
7.50	285.41	285.73	286.06	286.39	286.72	287.04	287.37	287.70	288.02	288.35	288.68	7.50
7.60	288.68	289.00	289.33	289.66	289.98	290.31	290.64	290.96	291.29	291.62	291.94	7.60
7.70	291.94	292.27	292.60	292.92	293.25	293.58	293.90	294.23	294.56	294.88	295.21	7.70
7.80	295.21	295.54	295.86	296.19	296.52	296.84	297.17	297.49	297.82	298.15	298.47	7.80
7.90	298.47	298.80	299.13	299.45	299.78	300.11	300.43	300.76	301.08	301.41	301.74	7.90
8.00	301.74	302.06	302.39	302.72	303.04	303.37	303.69	304.02	304.35	304.67	305.00	8.00
8.10	305.00	305.33	305.65	305.98	306.30	306.63	306.96	307.28	307.61	307.93	308.26	8.10
8.20	308.26	308.59	308.91	309.24	309.56	309.89	310.22	310.54	310.87	311.19	311.52	8.20
8.30	311.52	311.85	312.17	312.50	312.82	313.15	313.48	313.80	314.13	314.45	314.78	8.30
8.40	314.78	315.11	315.43	315.76	316.08	316.41	316.73	317.06	317.39	317.71	318.04	8.40
8.50	318.04	318.36	318.69	319.01	319.34	319.67	319.99	320.32	320.64	320.97	321.29	8.50
8.60	321.29	321.62	321.95	322.27	322.60	322.92	323.25	323.57	323.90	324.22	324.55	8.60
8.70	324.55	324.88	325.20	325.53	325.85	326.18	326.50	326.83	327.15	327.48	327.81	8.70
8.80	327.81	328.13	328.46	328.78	329.11	329.43	329.76	330.08	330.41	330.73	331.06	8.80
8.90	331.06	331.38	331.71	332.04	332.36	332.69	333.01	333.34	333.66	333.99	334.31	8.90
9.00	334.31	334.64	334.96	335.29	335.61	335.94	336.26	336.59	336.91	337.24	337.56	9.00
9.10	337.56	337.89	338.22	338.54	338.87	339.19	339.52	339.84	340.17	340.49	340.82	9.10
9.20	340.82	341.14	341.47	341.79	342.12	342.44	342.77	343.09	343.42	343.74	344.07	9.20
9.30	344.07	344.39	344.72	345.04	345.37	345.69	346.02	346.34	346.67	346.99	347.32	9.30
9.40	347.32	347.64	347.97	348.29	348.62	348.94	349.27	349.59	349.92	350.24	350.57	9.40
9.50	350.57	350.89	351.22	351.54	351.87	352.19	352.52	352.84	353.17	353.49	353.82	9.50
9.60	353.82	354.14	354.47	354.79	355.12	355.44	355.77	356.09	356.41	356.74	357.06	9.60
9.70	357.06	357.39	357.71	358.04	358.36	358.69	359.01	359.34	359.66	359.99	360.31	9.70
9.80	360.31	360.64	360.96	361.29	361.61	361.94	362.26	362.58	362.91	363.23	363.56	9.80
9.90	363.56	363.88	364.21	364.53	364.86	365.18	365.51	365.83	366.16	366.48	366.81	9.90
10.00	366.81	367.13	367.45	367.78	368.10	368.43	368.75	369.08	369.40	369.73	370.05	10.00
10.10	370.05	370.38	370.70	371.03	371.35	371.67	372.00	372.32	372.65	372.97	373.30	10.10
10.20	373.30	373.62	373.95	374.27	374.60	374.92	375.24	375.57	375.89	376.22	376.54	10.20
10.30	376.54	376.87	377.19	377.52	377.84	378.16	378.49	378.81	379.14	379.46	379.79	10.30
10.40	379.79	380.11	380.44	380.76	381.08	381.41	381.73	382.06	382.38	382.71	383.03	10.40
10.50	383.03	383.36	383.68	384.00	384.33	384.65	384.98	385.30	385.63	385.95	386.27	10.50
10.60	386.27	386.60	386.92	387.25	387.57	387.90	388.22	388.55	388.87	389.19	389.52	10.60
10.70	389.52	389.84	390.17	390.49	390.82	391.14	391.46	391.79	392.11	392.44	392.76	10.70
10.80	392.76	393.09	393.41	393.73	394.06	394.38	394.71	395.03	395.36	395.68	396.00	10.80
10.90	396.00	396.33	396.65	396.98	397.30	397.63	397.95	398.27	398.60	398.92	399.25	10.90
11.00	399.25	399.57	399.90	400.22	400.54	400.87	401.19	401.52	401.84	402.17	402.49	11.00
11.10	402.49	402.81	403.14	403.46	403.79	404.11	404.43	404.76	405.08	405.41	405.73	11.10
11.20	405.73	406.06	406.38	406.70	407.03	407.35	407.68	408.00	408.33	408.65	408.97	11.20
11.30	408.97	409.30	409.62	409.95	410.27	410.59	410.92	411.24	411.57	411.89	412.22	11.30
11.40	412.22	412.54	412.86	413.19	413.51	413.84	414.16	414.48	414.81	415.13	415.46	11.40
11.50	415.46	415.78	416.11	416.43	416.75	417.08	417.40	417.73	418.05	418.37	418.70	11.50
11.60	418.70	419.02	419.35	419.67	420.00	420.32	420.64	420.97	421.29	421.62	421.94	11.60
11.70	421.94	422.26	422.59	422.91	423.24	423.56	423.88	424.21	424.53	424.86	425.18	11.70
11.80	425.18	425.51	425.83	426.15	426.48	426.80	427.13	427.45	427.77	428.10	428.42	11.80
11.90	428.42	428.75	429.07	429.39	429.72	430.04	430.37	430.69	431.02	431.34	431.66	11.90
12.00	431.66	431.99	432.31	432.64	432.96	433.28	433.61	433.93	434.26	434.58	434.90	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
12.00	431.66	431.99	432.31	432.64	432.96	433.28	433.61	433.93	434.26	434.58	434.90	12.00
12.10	434.90	435.23	435.55	435.88	436.20	436.52	436.85	437.17	437.50	437.82	438.15	12.10
12.20	438.15	438.47	438.79	439.12	439.44	439.77	440.09	440.41	440.74	441.06	441.39	12.20
12.30	441.39	441.71	442.03	442.36	442.68	443.01	443.33	443.66	443.98	444.30	444.63	12.30
12.40	444.63	444.95	445.28	445.60	445.92	446.25	446.57	446.90	447.22	447.54	447.87	12.40
12.50	447.87	448.19	448.52	448.84	449.16	449.49	449.81	450.14	450.46	450.79	451.11	12.50
12.60	451.11	451.43	451.76	452.08	452.41	452.73	453.05	453.38	453.70	454.03	454.35	12.60
12.70	454.35	454.67	455.00	455.32	455.65	455.97	456.30	456.62	456.94	457.27	457.59	12.70
12.80	457.59	457.92	458.24	458.56	458.89	459.21	459.54	459.86	460.19	460.51	460.83	12.80
12.90	460.83	461.16	461.48	461.81	462.13	462.45	462.78	463.10	463.43	463.75	464.07	12.90
13.00	464.07	464.40	464.72	465.05	465.37	465.70	466.02	466.34	466.67	466.99	467.32	13.00
13.10	467.32	467.64	467.96	468.29	468.61	468.94	469.26	469.59	469.91	470.23	470.56	13.10
13.20	470.56	470.88	471.21	471.53	471.85	472.18	472.50	472.83	473.15	473.48	473.80	13.20
13.30	473.80	474.12	474.45	474.77	475.10	475.42	475.75	476.07	476.39	476.72	477.04	13.30
13.40	477.04	477.37	477.69	478.01	478.34	478.66	478.99	479.31	479.64	479.96	480.28	13.40
13.50	480.28	480.61	480.93	481.26	481.58	481.91	482.23	482.55	482.88	483.20	483.53	13.50
13.60	483.53	483.85	484.18	484.50	484.82	485.15	485.47	485.80	486.12	486.45	486.77	13.60
13.70	486.77	487.09	487.42	487.74	488.07	488.39	488.72	489.04	489.36	489.69	490.01	13.70
13.80	490.01	490.34	490.66	490.99	491.31	491.63	491.96	492.28	492.61	492.93	493.26	13.80
13.90	493.26	493.58	493.90	494.23	494.55	494.88	495.20	495.53	495.85	496.17	496.50	13.90
14.00	496.50	496.82	497.15	497.47	497.80	498.12	498.44	498.77	499.09	499.42	499.74	14.00
14.10	499.74	500.07	500.39	500.72	501.04	501.36	501.69	502.01	502.34	502.66	502.99	14.10
14.20	502.99	503.31	503.63	503.96	504.28	504.61	504.93	505.26	505.58	505.91	506.23	14.20
14.30	506.23	506.55	506.88	507.20	507.53	507.85	508.18	508.50	508.83	509.15	509.47	14.30
14.40	509.47	509.80	510.12	510.45	510.77	511.10	511.42	511.75	512.07	512.39	512.72	14.40
14.50	512.72	513.04	513.37	513.69	514.02	514.34	514.67	514.99	515.32	515.64	515.96	14.50
14.60	515.96	516.29	516.61	516.94	517.26	517.59	517.91	518.24	518.56	518.89	519.21	14.60
14.70	519.21	519.53	519.86	520.18	520.51	520.83	521.16	521.48	521.81	522.13	522.46	14.70
14.80	522.46	522.78	523.10	523.43	523.75	524.08	524.40	524.73	525.05	525.38	525.70	14.80
14.90	525.70	526.03	526.35	526.68	527.00	527.32	527.65	527.97	528.30	528.62	528.95	14.90
15.00	528.95	529.27	529.60	529.92	530.25	530.57	530.90	531.22	531.55	531.87	532.19	15.00
15.10	532.19	532.52	532.84	533.17	533.49	533.82	534.14	534.47	534.79	535.12	535.44	15.10
15.20	535.44	535.77	536.09	536.42	536.74	537.07	537.39	537.71	538.04	538.36	538.69	15.20
15.30	538.69	539.01	539.34	539.66	539.99	540.31	540.64	540.96	541.29	541.61	541.94	15.30
15.40	541.94	542.26	542.59	542.91	543.24	543.56	543.89	544.21	544.54	544.86	545.18	15.40
15.50	545.18	545.51	545.83	546.16	546.48	546.81	547.13	547.46	547.78	548.11	548.43	15.50
15.60	548.43	548.76	549.08	549.41	549.73	550.06	550.38	550.71	551.03	551.36	551.68	15.60
15.70	551.68	552.01	552.33	552.66	552.98	553.31	553.63	553.96	554.28	554.61	554.93	15.70
15.80	554.93	555.26	555.58	555.91	556.23	556.56	556.88	557.21	557.53	557.86	558.18	15.80
15.90	558.18	558.51	558.83	559.16	559.48	559.81	560.13	560.46	560.78	561.11	561.43	15.90
16.00	561.43	561.76	562.08	562.41	562.73	563.06	563.38	563.71	564.03	564.36	564.68	16.00
16.10	564.68	565.01	565.33	565.66	565.98	566.31	566.63	566.96	567.28	567.61	567.93	16.10
16.20	567.93	568.26	568.58	568.91	569.23	569.56	569.88	570.21	570.53	570.86	571.18	16.20
16.30	571.18	571.51	571.83	572.16	572.48	572.81	573.13	573.46	573.78	574.11	574.44	16.30
16.40	574.44	574.76	575.09	575.41	575.74	576.06	576.39	576.71	577.04	577.36	577.69	16.40
16.50	577.69	578.01	578.34	578.66	578.99	579.31	579.64	579.96	580.29	580.61	580.94	16.50
16.60	580.94	581.26	581.59	581.92	582.24	582.57	582.89	583.22	583.54	583.87	584.19	16.60
16.70	584.19	584.52	584.84	585.17	585.49	585.82	586.14	586.47	586.79	587.12	587.45	16.70
16.80	587.45	587.77	588.10	588.42	588.75	589.07	589.40	589.72	590.05	590.37	590.70	16.80
16.90	590.70	591.02	591.35	591.68	592.00	592.33	592.65	592.98	593.30	593.63	593.95	16.90
17.00	593.95	594.28	594.60	594.93	595.26	595.58	595.91	596.23	596.56	596.88	597.21	17.00
17.10	597.21	597.53	597.86	598.18	598.51	598.84	599.16	599.49	599.81	600.14	600.46	17.10
17.20	600.46	600.79	601.11	601.44	601.76	602.09	602.42	602.74	603.07	603.39	603.72	17.20
17.30	603.72	604.04	604.37	604.69	605.02	605.35	605.67	606.00	606.32	606.65	606.97	17.30
17.40	606.97	607.30	607.62	607.95	608.28	608.60	608.93	609.25	609.58	609.90	610.23	17.40
17.50	610.23	610.55	610.88	611.21	611.53	611.86	612.18	612.51	612.83	613.16	613.49	17.50
17.60	613.49	613.81	614.14	614.46	614.79	615.11	615.44	615.77	616.09	616.42	616.74	17.60
17.70	616.74	617.07	617.39	617.72	618.05	618.37	618.70	619.02	619.35	619.67	620.00	17.70
17.80	620.00	620.33	620.65	620.98	621.30	621.63	621.95	622.28	622.61	622.93	623.26	17.80
17.90	623.26	623.58	623.91	624.23	624.56	624.89	625.21	625.54	625.86	626.19	626.52	17.90
18.00	626.52	626.84	627.17	627.49	627.82	628.14	628.47	628.80	629.12	629.45	629.77	18.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
18.00	626.52	626.84	627.17	627.49	627.82	628.14	628.47	628.80	629.12	629.45	629.77	18.00
18.10	629.77	630.10	630.43	630.75	631.08	631.40	631.73	632.05	632.38	632.71	633.03	18.10
18.20	633.03	633.36	633.68	634.01	634.34	634.66	634.99	635.31	635.64	635.97	636.29	18.20
18.30	636.29	636.62	636.94	637.27	637.59	637.92	638.25	638.57	638.90	639.22	639.55	18.30
18.40	639.55	639.88	640.20	640.53	640.85	641.18	641.51	641.83	642.16	642.48	642.81	18.40
18.50	642.81	643.14	643.46	643.79	644.11	644.44	644.77	645.09	645.42	645.74	646.07	18.50
18.60	646.07	646.40	646.72	647.05	647.37	647.70	648.03	648.35	648.68	649.00	649.33	18.60
18.70	649.33	649.66	649.98	650.31	650.63	650.96	651.29	651.61	651.94	652.26	652.59	18.70
18.80	652.59	652.92	653.24	653.57	653.90	654.22	654.55	654.87	655.20	655.53	655.85	18.80
18.90	655.85	656.18	656.50	656.83	657.16	657.48	657.81	658.13	658.46	658.79	659.11	18.90
19.00	659.11	659.44	659.77	660.09	660.42	660.74	661.07	661.40	661.72	662.05	662.37	19.00
19.10	662.37	662.70	663.03	663.35	663.68	664.01	664.33	664.66	664.98	665.31	665.64	19.10
19.20	665.64	665.96	666.29	666.62	666.94	667.27	667.59	667.92	668.25	668.57	668.90	19.20
19.30	668.90	669.23	669.55	669.88	670.20	670.53	670.86	671.18	671.51	671.83	672.16	19.30
19.40	672.16	672.49	672.81	673.14	673.47	673.79	674.12	674.45	674.77	675.10	675.42	19.40
19.50	675.42	675.75	676.08	676.40	676.73	677.06	677.38	677.71	678.03	678.36	678.69	19.50
19.60	678.69	679.01	679.34	679.67	679.99	680.32	680.64	680.97	681.30	681.62	681.95	19.60
19.70	681.95	682.28	682.60	682.93	683.26	683.58	683.91	684.23	684.56	684.89	685.21	19.70
19.80	685.21	685.54	685.87	686.19	686.52	686.84	687.17	687.50	687.82	688.15	688.48	19.80
19.90	688.48	688.80	689.13	689.46	689.78	690.11	690.43	690.76	691.09	691.41	691.74	19.90
20.00	691.74	692.07	692.39	692.72	693.05	693.37	693.70	694.03	694.35	694.68	695.00	20.00
20.10	695.00	695.33	695.66	695.98	696.31	696.64	696.96	697.29	697.62	697.94	698.27	20.10
20.20	698.27	698.59	698.92	699.25	699.57	699.90	700.23	700.55	700.88	701.21	701.53	20.20
20.30	701.53	701.86	702.19	702.51	702.84	703.16	703.49	703.82	704.14	704.47	704.80	20.30
20.40	704.80	705.12	705.45	705.78	706.10	706.43	706.76	707.08	707.41	707.73	708.06	20.40
20.50	708.06	708.39	708.71	709.04	709.37	709.69	710.02	710.35	710.67	711.00	711.33	20.50
20.60	711.33	711.65	711.98	712.31	712.63	712.96	713.28	713.61	713.94	714.26	714.59	20.60
20.70	714.59	714.92	715.24	715.57	715.90	716.22	716.55	716.88	717.20	717.53	717.86	20.70
20.80	717.86	718.18	718.51	718.83	719.16	719.49	719.81	720.14	720.47	720.79	721.12	20.80
20.90	721.12	721.45	721.77	722.10	722.43	722.75	723.08	723.41	723.73	724.06	724.38	20.90
21.00	724.38	724.71	725.04	725.36	725.69	726.02	726.34	726.67	727.00	727.32	727.65	21.00
21.10	727.65	727.98	728.30	728.63	728.96	729.28	729.61	729.94	730.26	730.59	730.91	21.10
21.20	730.91	731.24	731.57	731.89	732.22	732.55	732.87	733.20	733.53	733.85	734.18	21.20
21.30	734.18	734.51	734.83	735.16	735.49	735.81	736.14	736.46	736.79	737.12	737.44	21.30
21.40	737.44	737.77	738.10	738.42	738.75	739.08	739.40	739.73	740.06	740.38	740.71	21.40
21.50	740.71	741.04	741.36	741.69	742.01	742.34	742.67	742.99	743.32	743.65	743.97	21.50
21.60	743.97	744.30	744.63	744.95	745.28	745.61	745.93	746.26	746.59	746.91	747.24	21.60
21.70	747.24	747.56	747.89	748.22	748.54	748.87	749.20	749.52	749.85	750.18	750.50	21.70
21.80	750.50	750.83	751.16	751.48	751.81	752.13	752.46	752.79	753.11	753.44	753.77	21.80
21.90	753.77	754.09	754.42	754.75	755.07	755.40	755.73	756.05	756.38	756.70	757.03	21.90
22.00	757.03	757.36	757.68	758.01	758.34	758.66	758.99	759.32	759.64	759.97	760.29	22.00
22.10	760.29	760.62	760.95	761.27	761.60	761.93	762.25	762.58	762.91	763.23	763.56	22.10
22.20	763.56	763.89	764.21	764.54	764.86	765.19	765.52	765.84	766.17	766.50	766.82	22.20
22.30	766.82	767.15	767.48	767.80	768.13	768.45	768.78	769.11	769.43	769.76	770.09	22.30
22.40	770.09	770.41	770.74	771.06	771.39	771.72	772.04	772.37	772.70	773.02	773.35	22.40
22.50	773.35	773.68	774.00	774.33	774.65	774.98	775.31	775.63	775.96	776.29	776.61	22.50
22.60	776.61	776.94	777.26	777.59	777.92	778.24	778.57	778.90	779.22	779.55	779.87	22.60
22.70	779.87	780.20	780.53	780.85	781.18	781.51	781.83	782.16	782.48	782.81	783.14	22.70
22.80	783.14	783.46	783.79	784.11	784.44	784.77	785.09	785.42	785.75	786.07	786.40	22.80
22.90	786.40	786.72	787.05	787.38	787.70	788.03	788.35	788.68	789.01	789.33	789.66	22.90
23.00	789.66	789.99	790.31	790.64	790.96	791.29	791.62	791.94	792.27	792.59	792.92	23.00
23.10	792.92	793.25	793.57	793.90	794.22	794.55	794.88	795.20	795.53	795.86	796.18	23.10
23.20	796.18	796.51	796.83	797.16	797.49	797.81	798.14	798.46	798.79	799.12	799.44	23.20
23.30	799.44	799.77	800.09	800.42	800.75	801.07	801.40	801.72	802.05	802.38	802.70	23.30
23.40	802.70	803.03	803.35	803.68	804.00	804.33	804.66	804.98	805.31	805.63	805.96	23.40
23.50	805.96	806.29	806.61	806.94	807.26	807.59	807.92	808.24	808.57	808.89	809.22	23.50
23.60	809.22	809.54	809.87	810.20	810.52	810.85	811.17	811.50	811.83	812.15	812.48	23.60
23.70	812.48	812.80	813.13	813.45	813.78	814.11	814.43	814.76	815.08	815.41	815.73	23.70
23.80	815.73	816.06	816.39	816.71	817.04	817.36	817.69	818.01	818.34	818.67	818.99	23.80
23.90	818.99	819.32	819.64	819.97	820.29	820.62	820.95	821.27	821.60	821.92	822.25	23.90
24.00	822.25	822.57	822.90	823.22	823.55	823.88	824.20	824.53	824.85	825.18	825.50	24.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
24.00	822.25	822.57	822.90	823.22	823.55	823.88	824.20	824.53	824.85	825.18	825.50	24.00
24.10	825.50	825.83	826.15	826.48	826.81	827.13	827.46	827.78	828.11	828.43	828.76	24.10
24.20	828.76	829.08	829.41	829.73	830.06	830.39	830.71	831.04	831.36	831.69	832.01	24.20
24.30	832.01	832.34	832.66	832.99	833.31	833.64	833.96	834.29	834.62	834.94	835.27	24.30
24.40	835.27	835.59	835.92	836.24	836.57	836.89	837.22	837.54	837.87	838.19	838.52	24.40
24.50	838.52	838.84	839.17	839.49	839.82	840.14	840.47	840.79	841.12	841.45	841.77	24.50
24.60	841.77	842.10	842.42	842.75	843.07	843.40	843.72	844.05	844.37	844.70	845.02	24.60
24.70	845.02	845.35	845.67	846.00	846.32	846.65	846.97	847.30	847.62	847.95	848.27	24.70
24.80	848.27	848.60	848.92	849.25	849.57	849.90	850.22	850.55	850.87	851.20	851.52	24.80
24.90	851.52	851.85	852.17	852.50	852.82	853.15	853.47	853.79	854.12	854.44	854.77	24.90
25.00	854.77	855.09	855.42	855.74	856.07	856.39	856.72	857.04	857.37	857.69	858.02	25.00
25.10	858.02	858.34	858.67	858.99	859.32	859.64	859.96	860.29	860.61	860.94	861.26	25.10
25.20	861.26	861.59	861.91	862.24	862.56	862.89	863.21	863.54	863.86	864.18	864.51	25.20
25.30	864.51	864.83	865.16	865.48	865.81	866.13	866.46	866.78	867.10	867.43	867.75	25.30
25.40	867.75	868.08	868.40	868.73	869.05	869.37	869.70	870.02	870.35	870.67	871.00	25.40
25.50	871.00	871.32	871.64	871.97	872.29	872.62	872.94	873.27	873.59	873.91	874.24	25.50
25.60	874.24	874.56	874.89	875.21	875.54	875.86	876.18	876.51	876.83	877.16	877.48	25.60
25.70	877.48	877.80	878.13	878.45	878.78	879.10	879.42	879.75	880.07	880.40	880.72	25.70
25.80	880.72	881.04	881.37	881.69	882.02	882.34	882.66	882.99	883.31	883.63	883.96	25.80
25.90	883.96	884.28	884.61	884.93	885.25	885.58	885.90	886.23	886.55	886.87	887.20	25.90
26.00	887.20	887.52	887.84	888.17	888.49	888.81	889.14	889.46	889.79	890.11	890.43	26.00
26.10	890.43	890.76	891.08	891.40	891.73	892.05	892.37	892.70	893.02	893.34	893.67	26.10
26.20	893.67	893.99	894.31	894.64	894.96	895.28	895.61	895.93	896.25	896.58	896.90	26.20
26.30	896.90	897.22	897.55	897.87	898.19	898.52	898.84	899.16	899.49	899.81	900.13	26.30
26.40	900.13	900.46	900.78	901.10	901.43	901.75	902.07	902.40	902.72	903.04	903.37	26.40
26.50	903.37	903.69	904.01	904.33	904.66	904.98	905.30	905.63	905.95	906.27	906.59	26.50
26.60	906.59	906.92	907.24	907.56	907.89	908.21	908.53	908.85	909.18	909.50	909.82	26.60
26.70	909.82	910.15	910.47	910.79	911.11	911.44	911.76	912.08	912.40	912.73	913.05	26.70
26.80	913.05	913.37	913.69	914.02	914.34	914.66	914.99	915.31	915.63	915.95	916.28	26.80
26.90	916.28	916.60	916.92	917.24	917.56	917.89	918.21	918.53	918.85	919.18	919.50	26.90
27.00	919.50	919.82	920.14	920.47	920.79	921.11	921.43	921.75	922.08	922.40	922.72	27.00
27.10	922.72	923.04	923.37	923.69	924.01	924.33	924.65	924.98	925.30	925.62	925.94	27.10
27.20	925.94	926.26	926.59	926.91	927.23	927.55	927.87	928.20	928.52	928.84	929.16	27.20
27.30	929.16	929.48	929.80	930.13	930.45	930.77	931.09	931.41	931.73	932.06	932.38	27.30
27.40	932.38	932.70	933.02	933.34	933.66	933.99	934.31	934.63	934.95	935.27	935.59	27.40
27.50	935.59	935.92	936.24	936.56	936.88	937.20	937.52	937.84	938.17	938.49	938.81	27.50
27.60	938.81	939.13	939.45	939.77	940.09	940.41	940.74	941.06	941.38	941.70	942.02	27.60
27.70	942.02	942.34	942.66	942.98	943.30	943.63	943.95	944.27	944.59	944.91	945.23	27.70
27.80	945.23	945.55	945.87	946.19	946.51	946.84	947.16	947.48	947.80	948.12	948.44	27.80
27.90	948.44	948.76	949.08	949.40	949.72	950.04	950.36	950.68	951.00	951.33	951.65	27.90
28.00	951.65	951.97	952.29	952.61	952.93	953.25	953.57	953.89	954.21	954.53	954.85	28.00
28.10	954.85	955.17	955.49	955.81	956.13	956.45	956.77	957.09	957.41	957.73	958.05	28.10
28.20	958.05	958.37	958.69	959.01	959.33	959.65	959.97	960.30	960.62	960.94	961.26	28.20
28.30	961.26	961.58	961.90	962.22	962.54	962.86	963.18	963.49	963.81	964.13	964.45	28.30
28.40	964.45	964.77	965.09	965.41	965.73	966.05	966.37	966.69	967.01	967.33	967.65	28.40
28.50	967.65	967.97	968.29	968.61	968.93	969.25	969.57	969.89	970.21	970.53	970.85	28.50
28.60	970.85	971.17	971.49	971.81	972.12	972.44	972.76	973.08	973.40	973.72	974.04	28.60
28.70	974.04	974.36	974.68	975.00	975.32	975.64	975.96	976.27	976.59	976.91	977.23	28.70
28.80	977.23	977.55	977.87	978.19	978.51	978.83	979.15	979.46	979.78	980.10	980.42	28.80
28.90	980.42	980.74	981.06	981.38	981.70	982.01	982.33	982.65	982.97	983.29	983.61	28.90
29.00	983.61	983.93	984.24	984.56	984.88	985.20	985.52	985.84	986.16	986.47	986.79	29.00
29.10	986.79	987.11	987.43	987.75	988.07	988.38	988.70	989.02	989.34	989.66	989.97	29.10
29.20	989.97	990.29	990.61	990.93	991.25	991.57	991.88	992.20	992.52	992.84	993.16	29.20
29.30	993.16	993.47	993.79	994.11	994.43	994.74	995.06	995.38	995.70	996.02	996.33	29.30
29.40	996.33	996.65	996.97	997.29	997.60	997.92	998.24	998.56	998.87	999.19	999.51	29.40
29.50	999.51	999.83	1000.14	1000.46	1000.78	1001.10	1001.41	1001.73	1002.05	1002.37	1002.68	29.50
29.60	1002.68	1003.00	1003.32	1003.63	1003.95	1004.27	1004.59	1004.90	1005.22	1005.54	1005.85	29.60
29.70	1005.85	1006.17	1006.49	1006.80	1007.12	1007.44	1007.76	1008.07	1008.39	1008.71	1009.02	29.70
29.80	1009.02	1009.34	1009.66	1009.97	1010.29	1010.61	1010.92	1011.24	1011.56	1011.87	1012.19	29.80
29.90	1012.19	1012.51	1012.82	1013.14	1013.46	1013.77	1014.09	1014.40	1014.72	1015.04	1015.35	29.90
30.00	1015.35	1015.67	1015.99	1016.30	1016.62	1016.93	1017.25	1017.57	1017.88	1018.20	1018.52	30.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
30.00	1015.35	1015.67	1015.99	1016.30	1016.62	1016.93	1017.25	1017.57	1017.88	1018.20	1018.52	30.00
30.10	1018.52	1018.83	1019.15	1019.46	1019.78	1020.09	1020.41	1020.73	1021.04	1021.36	1021.67	30.10
30.20	1021.67	1021.99	1022.31	1022.62	1022.94	1023.25	1023.57	1023.88	1024.20	1024.52	1024.83	30.20
30.30	1024.83	1025.15	1025.46	1025.78	1026.09	1026.41	1026.72	1027.04	1027.35	1027.67	1027.99	30.30
30.40	1027.99	1028.30	1028.62	1028.93	1029.25	1029.56	1029.88	1030.19	1030.51	1030.82	1031.14	30.40
30.50	1031.14	1031.45	1031.77	1032.08	1032.40	1032.71	1033.03	1033.34	1033.66	1033.97	1034.29	30.50
30.60	1034.29	1034.60	1034.92	1035.23	1035.55	1035.86	1036.17	1036.49	1036.80	1037.12	1037.43	30.60
30.70	1037.43	1037.75	1038.06	1038.38	1038.69	1039.01	1039.32	1039.63	1039.95	1040.26	1040.58	30.70
30.80	1040.58	1040.89	1041.21	1041.52	1041.83	1042.15	1042.46	1042.78	1043.09	1043.40	1043.72	30.80
30.90	1043.72	1044.03	1044.35	1044.66	1044.97	1045.29	1045.60	1045.92	1046.23	1046.54	1046.86	30.90
31.00	1046.86	1047.17	1047.48	1047.80	1048.11	1048.43	1048.74	1049.05	1049.37	1049.68	1049.99	31.00
31.10	1049.99	1050.31	1050.62	1050.93	1051.25	1051.56	1051.87	1052.19	1052.50	1052.81	1053.13	31.10
31.20	1053.13	1053.44	1053.75	1054.07	1054.38	1054.69	1055.00	1055.32	1055.63	1055.94	1056.26	31.20
31.30	1056.26	1056.57	1056.88	1057.20	1057.51	1057.82	1058.13	1058.45	1058.76	1059.07	1059.38	31.30
31.40	1059.38	1059.70	1060.01	1060.32	1060.64	1060.95	1061.26	1061.57	1061.89	1062.20	1062.51	31.40
31.50	1062.51	1062.82	1063.13	1063.45	1063.76	1064.07	1064.38	1064.70	1065.01	1065.32	1065.63	31.50
31.60	1065.63	1065.94	1066.26	1066.57	1066.88	1067.19	1067.50	1067.82	1068.13	1068.44	1068.75	31.60
31.70	1068.75	1069.06	1069.38	1069.69	1070.00	1070.31	1070.62	1070.93	1071.25	1071.56	1071.87	31.70
31.80	1071.87	1072.18	1072.49	1072.80	1073.11	1073.43	1073.74	1074.05	1074.36	1074.67	1074.98	31.80
31.90	1074.98	1075.29	1075.61	1075.92	1076.23	1076.54	1076.85	1077.16	1077.47	1077.78	1078.09	31.90
32.00	1078.09	1078.40	1078.72	1079.03	1079.34	1079.65	1079.96	1080.27	1080.58	1080.89	1081.20	32.00
32.10	1081.20	1081.51	1081.82	1082.13	1082.44	1082.75	1083.07	1083.38	1083.69	1084.00	1084.31	32.10
32.20	1084.31	1084.62	1084.93	1085.24	1085.55	1085.86	1086.17	1086.48	1086.79	1087.10	1087.41	32.20
32.30	1087.41	1087.72	1088.03	1088.34	1088.65	1088.96	1089.27	1089.58	1089.89	1090.20	1090.51	32.30
32.40	1090.51	1090.82	1091.13	1091.44	1091.75	1092.06	1092.37	1092.68	1092.99	1093.30	1093.61	32.40
32.50	1093.61	1093.92	1094.22	1094.53	1094.84	1095.15	1095.46	1095.77	1096.08	1096.39	1096.70	32.50
32.60	1096.70	1097.01	1097.32	1097.63	1097.94	1098.24	1098.55	1098.86	1099.17	1099.48	1099.79	32.60
32.70	1099.79	1100.10	1100.41	1100.72	1101.03	1101.33	1101.64	1101.95	1102.26	1102.57	1102.88	32.70
32.80	1102.88	1103.19	1103.49	1103.80	1104.11	1104.42	1104.73	1105.04	1105.35	1105.65	1105.96	32.80
32.90	1105.96	1106.27	1106.58	1106.89	1107.19	1107.50	1107.81	1108.12	1108.43	1108.74	1109.04	32.90
33.00	1109.04	1109.35	1109.66	1109.97	1110.28	1110.58	1110.89	1111.20	1111.51	1111.81	1112.12	33.00
33.10	1112.12	1112.43	1112.74	1113.04	1113.35	1113.66	1113.97	1114.28	1114.58	1114.89	1115.20	33.10
33.20	1115.20	1115.50	1115.81	1116.12	1116.43	1116.73	1117.04	1117.35	1117.66	1117.96	1118.27	33.20
33.30	1118.27	1118.58	1118.88	1119.19	1119.50	1119.81	1120.11	1120.42	1120.73	1121.03	1121.34	33.30
33.40	1121.34	1121.65	1121.95	1122.26	1122.57	1122.87	1123.18	1123.49	1123.79	1124.10	1124.41	33.40
33.50	1124.41	1124.71	1125.02	1125.32	1125.63	1125.94	1126.24	1126.55	1126.86	1127.16	1127.47	33.50
33.60	1127.47	1127.78	1128.08	1128.39	1128.69	1129.00	1129.31	1129.61	1129.92	1130.22	1130.53	33.60
33.70	1130.53	1130.83	1131.14	1131.45	1131.75	1132.06	1132.36	1132.67	1132.97	1133.28	1133.59	33.70
33.80	1133.59	1133.89	1134.20	1134.50	1134.81	1135.11	1135.42	1135.72	1136.03	1136.33	1136.64	33.80
33.90	1136.64	1136.95	1137.25	1137.56	1137.86	1138.17	1138.47	1138.78	1139.08	1139.39	1139.69	33.90
34.00	1139.69	1140.00	1140.30	1140.61	1140.91	1141.21	1141.52	1141.82	1142.13	1142.43	1142.74	34.00
34.10	1142.74	1143.04	1143.35	1143.65	1143.96	1144.26	1144.57	1144.87	1145.17	1145.48	1145.78	34.10
34.20	1145.78	1146.09	1146.39	1146.70	1147.00	1147.30	1147.61	1147.91	1148.22	1148.52	1148.82	34.20
34.30	1148.82	1149.13	1149.43	1149.74	1150.04	1150.34	1150.65	1150.95	1151.26	1151.56	1151.86	34.30
34.40	1151.86	1152.17	1152.47	1152.77	1153.08	1153.38	1153.68	1153.99	1154.29	1154.59	1154.90	34.40
34.50	1154.90	1155.20	1155.50	1155.81	1156.11	1156.41	1156.72	1157.02	1157.32	1157.63	1157.93	34.50
34.60	1157.93	1158.23	1158.54	1158.84	1159.14	1159.44	1159.75	1160.05	1160.35	1160.66	1160.96	34.60
34.70	1160.96	1161.26	1161.56	1161.87	1162.17	1162.47	1162.77	1163.08	1163.38	1163.68	1163.98	34.70
34.80	1163.98	1164.29	1164.59	1164.89	1165.19	1165.50	1165.80	1166.10	1166.40	1166.70	1167.01	34.80
34.90	1167.01	1167.31	1167.61	1167.91	1168.21	1168.52	1168.82	1169.12	1169.42	1169.72	1170.03	34.90
35.00	1170.03	1170.33	1170.63	1170.93	1171.23	1171.53	1171.84	1172.14	1172.44	1172.74	1173.04	35.00
35.10	1173.04	1173.34	1173.64	1173.95	1174.25	1174.55	1174.85	1175.15	1175.45	1175.75	1176.05	35.10
35.20	1176.05	1176.35	1176.66	1176.96	1177.26	1177.56	1177.86	1178.16	1178.46	1178.76	1179.06	35.20
35.30	1179.06	1179.36	1179.67	1179.97	1180.27	1180.57	1180.87	1181.17	1181.47	1181.77	1182.07	35.30
35.40	1182.07	1182.37	1182.67	1182.97	1183.27	1183.57	1183.87	1184.17	1184.47	1184.77	1185.07	35.40
35.50	1185.07	1185.37	1185.67	1185.97	1186.27	1186.57	1186.87	1187.17	1187.47	1187.77	1188.07	35.50
35.60	1188.07	1188.37	1188.67	1188.97	1189.27	1189.57	1189.87	1190.17	1190.47	1190.77	1191.07	35.60
35.70	1191.07	1191.37	1191.67	1191.97	1192.27	1192.57	1192.87	1193.17	1193.47	1193.76	1194.06	35.70
35.80	1194.06	1194.36	1194.66	1194.96	1195.26	1195.56	1195.86	1196.16	1196.46	1196.76	1197.05	35.80
35.90	1197.05	1197.35	1197.65	1197.95	1198.25	1198.55	1198.85	1199.15	1199.46	1199.74	1200.04	35.90
36.00	1200.04	1200.34	1200.64	1200.94	1201.24	1201.53	1201.83	1202.13	1202.43	1202.73	1203.03	36.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
36.00	1200.04	1200.34	1200.64	1200.94	1201.24	1201.53	1201.83	1202.13	1202.43	1202.73	1203.03	36.00
36.10	1203.03	1203.32	1203.62	1203.92	1204.22	1204.52	1204.82	1205.11	1205.41	1205.71	1206.01	36.10
36.20	1206.01	1206.30	1206.60	1206.90	1207.20	1207.50	1207.79	1208.09	1208.39	1208.69	1208.98	36.20
36.30	1208.98	1209.28	1209.58	1209.88	1210.18	1210.47	1210.77	1211.07	1211.36	1211.66	1211.96	36.30
36.40	1211.96	1212.26	1212.55	1212.85	1213.15	1213.45	1213.74	1214.04	1214.34	1214.63	1214.93	36.40
36.50	1214.93	1215.23	1215.53	1215.82	1216.12	1216.42	1216.71	1217.01	1217.31	1217.60	1217.90	36.50
36.60	1217.90	1218.20	1218.49	1218.79	1219.09	1219.38	1219.68	1219.98	1220.27	1220.57	1220.87	36.60
36.70	1220.87	1221.16	1221.46	1221.75	1222.05	1222.35	1222.64	1222.94	1223.24	1223.53	1223.83	36.70
36.80	1223.83	1224.12	1224.42	1224.72	1225.01	1225.31	1225.60	1225.90	1226.19	1226.49	1226.79	36.80
36.90	1226.79	1227.08	1227.38	1227.67	1227.97	1228.26	1228.56	1228.86	1229.15	1229.45	1229.74	36.90
37.00	1229.74	1230.04	1230.33	1230.63	1230.92	1231.22	1231.51	1231.81	1232.10	1232.40	1232.70	37.00
37.10	1232.70	1232.99	1233.29	1233.58	1233.88	1234.17	1234.47	1234.76	1235.06	1235.35	1235.65	37.10
37.20	1235.65	1235.94	1236.23	1236.53	1236.82	1237.12	1237.41	1237.71	1238.00	1238.30	1238.59	37.20
37.30	1238.59	1238.89	1239.18	1239.48	1239.77	1240.06	1240.36	1240.65	1240.95	1241.24	1241.54	37.30
37.40	1241.54	1241.83	1242.12	1242.42	1242.71	1243.01	1243.30	1243.59	1243.89	1244.18	1244.48	37.40
37.50	1244.48	1244.77	1245.06	1245.36	1245.65	1245.95	1246.24	1246.53	1246.83	1247.12	1247.41	37.50
37.60	1247.41	1247.71	1248.00	1248.29	1248.59	1248.88	1249.17	1249.47	1249.76	1250.06	1250.35	37.60
37.70	1250.35	1250.64	1250.93	1251.23	1251.52	1251.81	1252.11	1252.40	1252.69	1252.99	1253.28	37.70
37.80	1253.28	1253.57	1253.87	1254.16	1254.45	1254.74	1255.04	1255.33	1255.62	1255.92	1256.21	37.80
37.90	1256.21	1256.50	1256.79	1257.09	1257.38	1257.67	1257.96	1258.26	1258.55	1258.84	1259.13	37.90
38.00	1259.13	1259.43	1259.72	1260.01	1260.30	1260.60	1260.89	1261.18	1261.47	1261.76	1262.06	38.00
38.10	1262.06	1262.35	1262.64	1262.93	1263.23	1263.52	1263.81	1264.10	1264.39	1264.68	1264.98	38.10
38.20	1264.98	1265.27	1265.56	1265.85	1266.14	1266.44	1266.73	1267.02	1267.31	1267.60	1267.89	38.20
38.30	1267.89	1268.19	1268.48	1268.77	1269.06	1269.35	1269.64	1269.93	1270.22	1270.52	1270.81	38.30
38.40	1270.81	1271.10	1271.39	1271.68	1271.97	1272.26	1272.55	1272.85	1273.14	1273.43	1273.72	38.40
38.50	1273.72	1274.01	1274.30	1274.59	1274.88	1275.17	1275.46	1275.75	1276.05	1276.34	1276.63	38.50
38.60	1276.63	1276.92	1277.21	1277.50	1277.79	1278.08	1278.37	1278.66	1278.95	1279.24	1279.53	38.60
38.70	1279.53	1279.82	1280.11	1280.40	1280.69	1280.98	1281.27	1281.56	1281.85	1282.14	1282.43	38.70
38.80	1282.43	1282.72	1283.01	1283.31	1283.60	1283.89	1284.18	1284.46	1284.75	1285.04	1285.33	38.80
38.90	1285.33	1285.62	1285.91	1286.20	1286.49	1286.78	1287.07	1287.36	1287.65	1287.94	1288.23	38.90
39.00	1288.23	1288.52	1288.81	1289.10	1289.39	1289.68	1289.97	1290.26	1290.55	1290.84	1291.13	39.00
39.10	1291.13	1291.42	1291.70	1291.99	1292.28	1292.57	1292.86	1293.15	1293.44	1293.73	1294.02	39.10
39.20	1294.02	1294.31	1294.60	1294.88	1295.17	1295.46	1295.75	1296.04	1296.33	1296.62	1296.91	39.20
39.30	1296.91	1297.20	1297.48	1297.77	1298.06	1298.35	1298.64	1298.93	1299.22	1299.50	1299.79	39.30
39.40	1299.79	1300.08	1300.37	1300.66	1300.95	1301.23	1301.52	1301.81	1302.10	1302.39	1302.68	39.40
39.50	1302.68	1302.96	1303.25	1303.54	1303.83	1304.12	1304.40	1304.69	1304.98	1305.27	1305.56	39.50
39.60	1305.56	1305.84	1306.13	1306.42	1306.71	1307.00	1307.28	1307.57	1307.86	1308.15	1308.44	39.60
39.70	1308.44	1308.72	1309.01	1309.30	1309.59	1309.87	1310.16	1310.45	1310.74	1311.02	1311.31	39.70
39.80	1311.31	1311.60	1311.89	1312.17	1312.46	1312.75	1313.04	1313.32	1313.61	1313.90	1314.18	39.80
39.90	1314.18	1314.47	1314.76	1315.05	1315.33	1315.62	1315.91	1316.19	1316.48	1316.77	1317.06	39.90
40.00	1317.06	1317.34	1317.63	1317.92	1318.20	1318.49	1318.78	1319.06	1319.35	1319.64	1319.92	40.00
40.10	1319.92	1320.21	1320.50	1320.78	1321.07	1321.36	1321.64	1321.93	1322.22	1322.50	1322.79	40.10
40.20	1322.79	1323.08	1323.36	1323.65	1323.93	1324.22	1324.51	1324.79	1325.08	1325.37	1325.65	40.20
40.30	1325.65	1325.94	1326.23	1326.51	1326.80	1327.08	1327.37	1327.66	1327.94	1328.23	1328.51	40.30
40.40	1328.51	1328.80	1329.09	1329.37	1329.66	1329.94	1330.23	1330.52	1330.80	1331.09	1331.37	40.40
40.50	1331.37	1331.66	1331.94	1332.23	1332.52	1332.80	1333.09	1333.37	1333.66	1333.94	1334.23	40.50
40.60	1334.23	1334.51	1334.80	1335.09	1335.37	1335.66	1335.94	1336.23	1336.51	1336.80	1337.08	40.60
40.70	1337.08	1337.37	1337.65	1337.94	1338.22	1338.51	1338.79	1339.08	1339.36	1339.65	1339.94	40.70
40.80	1339.94	1340.22	1340.51	1340.79	1341.08	1341.36	1341.65	1341.93	1342.22	1342.50	1342.78	40.80
40.90	1342.78	1343.07	1343.35	1343.64	1343.92	1344.21	1344.49	1344.78	1345.06	1345.35	1345.63	40.90
41.00	1345.63	1345.92	1346.20	1346.49	1346.77	1347.06	1347.34	1347.62	1347.91	1348.19	1348.48	41.00
41.10	1348.48	1348.76	1349.05	1349.33	1349.62	1349.90	1350.18	1350.47	1350.75	1351.04	1351.32	41.10
41.20	1351.32	1351.61	1351.89	1352.17	1352.46	1352.74	1353.03	1353.31	1353.59	1353.88	1354.16	41.20
41.30	1354.16	1354.45	1354.73	1355.01	1355.30	1355.58	1355.87	1356.15	1356.43	1356.72	1357.00	41.30
41.40	1357.00	1357.29	1357.57	1357.85	1358.14	1358.42	1358.70	1358.99	1359.27	1359.56	1359.84	41.40
41.50	1359.84	1360.12	1360.41	1360.69	1360.97	1361.26	1361.54	1361.82	1362.11	1362.39	1362.67	41.50
41.60	1362.67	1362.96	1363.24	1363.53	1363.81	1364.09	1364.38	1364.66	1364.94	1365.23	1365.51	41.60
41.70	1365.51	1365.79	1366.07	1366.36	1366.64	1366.92	1367.21	1367.49	1367.77	1368.06	1368.34	41.70
41.80	1368.34	1368.62	1368.91	1369.19	1369.47	1369.76	1370.04	1370.32	1370.60	1370.89	1371.17	41.80
41.90	1371.17	1371.45	1371.74	1372.02	1372.30	1372.58	1372.87	1373.15	1373.43	1373.72	1374.00	41.90
42.00	1374.00	1374.28	1374.56	1374.85	1375.13	1375.41	1375.69	1375.98	1376.26	1376.54	1376.82	42.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
42.00	1374.00	1374.28	1374.56	1374.85	1375.13	1375.41	1375.69	1375.98	1376.26	1376.54	1376.82	42.00
42.10	1376.82	1377.11	1377.39	1377.67	1377.95	1378.24	1378.52	1378.80	1379.08	1379.37	1379.65	42.10
42.20	1379.65	1379.93	1380.21	1380.50	1380.78	1381.06	1381.34	1381.63	1381.91	1382.19	1382.47	42.20
42.30	1382.47	1382.76	1383.04	1383.32	1383.60	1383.88	1384.17	1384.45	1384.73	1385.01	1385.29	42.30
42.40	1385.29	1385.58	1385.86	1386.14	1386.42	1386.71	1386.99	1387.27	1387.55	1387.83	1388.12	42.40
42.50	1388.12	1388.40	1388.68	1388.96	1389.24	1389.52	1389.81	1390.09	1390.37	1390.65	1390.93	42.50
42.60	1390.93	1391.22	1391.50	1391.78	1392.06	1392.34	1392.62	1392.91	1393.19	1393.47	1393.75	42.60
42.70	1393.75	1394.03	1394.31	1394.60	1394.88	1395.16	1395.44	1395.72	1396.00	1396.29	1396.57	42.70
42.80	1396.57	1396.85	1397.13	1397.41	1397.69	1397.97	1398.26	1398.54	1398.82	1399.10	1399.38	42.80
42.90	1399.38	1399.66	1399.94									42.90
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples extended range—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
42.90				1400.23	1400.51	1400.79	1401.07	1401.35	1401.63	1401.92	1402.20	42.90
43.00	1402.20	1402.48	1402.76	1403.04	1403.32	1403.60	1403.88	1404.16	1404.45	1404.73	1405.01	43.00
43.10	1405.01	1405.29	1405.57	1405.85	1406.13	1406.41	1406.69	1406.97	1407.26	1407.54	1407.82	43.10
43.20	1407.82	1408.10	1408.38	1408.66	1408.94	1409.22	1409.50	1409.78	1410.06	1410.34	1410.62	43.20
43.30	1410.62	1410.90	1411.18	1411.47	1411.75	1412.03	1412.31	1412.59	1412.87	1413.15	1413.43	43.30
43.40	1413.43	1413.71	1413.99	1414.27	1414.55	1414.83	1415.11	1415.39	1415.67	1415.95	1416.23	43.40
43.50	1416.23	1416.51	1416.79	1417.07	1417.35	1417.63	1417.91	1418.19	1418.47	1418.75	1419.03	43.50
43.60	1419.03	1419.31	1419.59	1419.87	1420.15	1420.43	1420.71	1420.99	1421.27	1421.55	1421.83	43.60
43.70	1421.83	1422.11	1422.39	1422.67	1422.95	1423.23	1423.51	1423.79	1424.07	1424.35	1424.63	43.70
43.80	1424.63	1424.91	1425.19	1425.47	1425.75	1426.03	1426.31	1426.59	1426.87	1427.15	1427.43	43.80
43.90	1427.43	1427.71	1427.99	1428.26	1428.54	1428.82	1429.10	1429.38	1429.66	1429.94	1430.22	43.90
44.00	1430.22	1430.50	1430.78	1431.06	1431.34	1431.62	1431.90	1432.18	1432.46	1432.74	1433.02	44.00
44.10	1433.02	1433.29	1433.57	1433.85	1434.13	1434.41	1434.69	1434.97	1435.25	1435.53	1435.81	44.10
44.20	1435.81	1436.09	1436.37	1436.65	1436.92	1437.20	1437.48	1437.76	1438.04	1438.32	1438.60	44.20
44.30	1438.60	1438.88	1439.16	1439.44	1439.72	1440.00	1440.27	1440.55	1440.83	1441.11	1441.39	44.30
44.40	1441.39	1441.67	1441.95	1442.23	1442.51	1442.79	1443.06	1443.34	1443.62	1443.90	1444.18	44.40
44.50	1444.18	1444.46	1444.74	1445.02	1445.30	1445.58	1445.85	1446.13	1446.41	1446.69	1446.97	44.50
44.60	1446.97	1447.25	1447.53	1447.81	1448.08	1448.36	1448.64	1448.92	1449.20	1449.48	1449.76	44.60
44.70	1449.76	1450.04	1450.32	1450.59	1450.87	1451.15	1451.43	1451.71	1451.99	1452.27	1452.55	44.70
44.80	1452.55	1452.82	1453.10	1453.38	1453.66	1453.94	1454.22	1454.50	1454.78	1455.05	1455.33	44.80
44.90	1455.33	1455.61	1455.89	1456.17	1456.45	1456.73	1457.01	1457.28	1457.56	1457.84	1458.12	44.90
45.00	1458.12	1458.40	1458.68	1458.96	1459.23	1459.51	1459.79	1460.07	1460.35	1460.63	1460.91	45.00
45.10	1460.91	1461.18	1461.46	1461.74	1462.02	1462.30	1462.58	1462.86	1463.14	1463.41	1463.69	45.10
45.20	1463.69	1463.97	1464.25	1464.53	1464.81	1465.09	1465.36	1465.64	1465.92	1466.20	1466.48	45.20
45.30	1466.48	1466.76	1467.04	1467.31	1467.59	1467.87	1468.15	1468.43	1468.71	1468.99	1469.26	45.30
45.40	1469.26	1469.54	1469.82	1470.10	1470.38	1470.66	1470.94	1471.21	1471.49	1471.77	1472.05	45.40
45.50	1472.05	1472.33	1472.61	1472.89	1473.16	1473.44	1473.72	1474.00	1474.28	1474.56	1474.84	45.50
45.60	1474.84	1475.11	1475.39	1475.67	1475.95	1476.23	1476.51	1476.79	1477.06	1477.34	1477.62	45.60
45.70	1477.62	1477.90	1478.18	1478.46	1478.74	1479.01	1479.29	1479.57	1479.85	1480.13	1480.41	45.70
45.80	1480.41	1480.69	1480.96	1481.24	1481.52	1481.80	1482.08	1482.36	1482.64	1482.91	1483.19	45.80
45.90	1483.19	1483.47	1483.75	1484.03	1484.31	1484.59	1484.87	1485.14	1485.42	1485.70	1485.98	45.90
46.00	1485.98	1486.26	1486.54	1486.82	1487.09	1487.37	1487.65	1487.93	1488.21	1488.49	1488.77	46.00
46.10	1488.77	1489.05	1489.32	1489.60	1489.88	1490.16	1490.44	1490.72	1491.00	1491.27	1491.55	46.10
46.20	1491.55	1491.83	1492.11	1492.39	1492.67	1492.95	1493.23	1493.50	1493.78	1494.06	1494.34	46.20
46.30	1494.34	1494.62	1494.90	1495.18	1495.46	1495.74	1496.01	1496.29	1496.57	1496.85	1497.13	46.30
46.40	1497.13	1497.41	1497.69	1497.97	1498.24	1498.52	1498.80	1499.08	1499.36	1499.64	1499.92	46.40
46.50	1499.92	1500.20	1500.48	1500.76	1501.03	1501.31	1501.59	1501.87	1502.15	1502.43	1502.71	46.50
46.60	1502.71	1502.99	1503.27	1503.54	1503.82	1504.10	1504.38	1504.66	1504.94	1505.22	1505.50	46.60
46.70	1505.50	1505.78	1506.06	1506.34	1506.61	1506.89	1507.17	1507.45	1507.73	1508.01	1508.29	46.70
46.80	1508.29	1508.57	1508.85	1509.13	1509.41	1509.68	1509.96	1510.24	1510.52	1510.80	1511.08	46.80
46.90	1511.08	1511.36	1511.64	1511.92	1512.20	1512.48	1512.76	1513.04	1513.31	1513.59	1513.87	46.90
47.00	1513.87	1514.15	1514.43	1514.71	1514.99	1515.27	1515.55	1515.83	1516.11	1516.39	1516.67	47.00
47.10	1516.67	1516.95	1517.23	1517.51	1517.78	1518.06	1518.34	1518.62	1518.90	1519.18	1519.46	47.10
47.20	1519.46	1519.74	1520.02	1520.30	1520.58	1520.86	1521.14	1521.42	1521.70	1521.98	1522.26	47.20
47.30	1522.26	1522.54	1522.82	1523.10	1523.38	1523.66	1523.94	1524.22	1524.49	1524.77	1525.05	47.30
47.40	1525.05	1525.33	1525.61	1525.89	1526.17	1526.45	1526.73	1527.01	1527.29	1527.57	1527.85	47.40
47.50	1527.85	1528.13	1528.41	1528.69	1528.97	1529.25	1529.53	1529.81	1530.09	1530.37	1530.65	47.50
47.60	1530.65	1530.93	1531.21	1531.49	1531.77	1532.05	1532.33	1532.61	1532.89	1533.17	1533.45	47.60
47.70	1533.45	1533.73	1534.01	1534.29	1534.57	1534.85	1535.13	1535.41	1535.69	1535.97	1536.25	47.70
47.80	1536.25	1536.53	1536.81	1537.09	1537.37	1537.66	1537.94	1538.22	1538.50	1538.78	1539.06	47.80
47.90	1539.06	1539.34	1539.62	1539.90	1540.18	1540.46	1540.74	1541.02	1541.30	1541.58	1541.86	47.90
48.00	1541.86	1542.14	1542.42	1542.70	1542.98	1543.26	1543.54	1543.83	1544.11	1544.39	1544.67	48.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples extended range—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
48.00	1541.86	1542.14	1542.42	1542.70	1542.98	1543.26	1543.54	1543.83	1544.11	1544.39	1544.67	48.00
48.10	1544.67	1544.95	1545.23	1545.51	1545.79	1546.07	1546.35	1546.63	1546.91	1547.19	1547.47	48.10
48.20	1547.47	1547.76	1548.04	1548.32	1548.60	1548.88	1549.16	1549.44	1549.72	1550.00	1550.28	48.20
48.30	1550.28	1550.56	1550.85	1551.13	1551.41	1551.69	1551.97	1552.25	1552.53	1552.81	1553.09	48.30
48.40	1553.09	1553.38	1553.66	1553.94	1554.22	1554.50	1554.78	1555.06	1555.34	1555.63	1555.91	48.40
48.50	1555.91	1556.19	1556.47	1556.75	1557.03	1557.31	1557.59	1557.88	1558.16	1558.44	1558.72	48.50
48.60	1558.72	1559.00	1559.28	1559.57	1559.85	1560.13	1560.41	1560.69	1560.97	1561.25	1561.54	48.60
48.70	1561.54	1561.82	1562.10	1562.38	1562.66	1562.94	1563.23	1563.51	1563.79	1564.07	1564.35	48.70
48.80	1564.35	1564.64	1564.92	1565.20	1565.48	1565.76	1566.04	1566.33	1566.61	1566.89	1567.17	48.80
48.90	1567.17	1567.45	1567.74	1568.02	1568.30	1568.58	1568.86	1569.15	1569.43	1569.71	1569.99	48.90
49.00	1569.99	1570.28	1570.56	1570.84	1571.12	1571.40	1571.69	1571.97	1572.25	1572.53	1572.82	49.00
49.10	1572.82	1573.10	1573.38	1573.66	1573.95	1574.23	1574.51	1574.79	1575.08	1575.36	1575.64	49.10
49.20	1575.64	1575.92	1576.21	1576.49	1576.77	1577.05	1577.34	1577.62	1577.90	1578.18	1578.47	49.20
49.30	1578.47	1578.75	1579.03	1579.32	1579.60	1579.88	1580.16	1580.45	1580.73	1581.01	1581.30	49.30
49.40	1581.30	1581.58	1581.86	1582.15	1582.43	1582.71	1582.99	1583.28	1583.56	1583.84	1584.13	49.40
49.50	1584.13	1584.41	1584.69	1584.98	1585.26	1585.54	1585.83	1586.11	1586.39	1586.68	1586.96	49.50
49.60	1586.96	1587.24	1587.53	1587.81	1588.09	1588.38	1588.66	1588.94	1589.23	1589.51	1589.79	49.60
49.70	1589.79	1590.08	1590.36	1590.64	1590.93	1591.21	1591.50	1591.78	1592.06	1592.35	1592.63	49.70
49.80	1592.63	1592.91	1593.20	1593.48	1593.77	1594.05	1594.33	1594.62	1594.90	1595.19	1595.47	49.80
49.90	1595.47	1595.75	1596.04	1596.32	1596.61	1596.89	1597.17	1597.46	1597.74	1598.03	1598.31	49.90
50.00	1598.31	1598.60	1598.88	1599.16	1599.45	1599.73	1600.02	1600.30	1600.59	1600.87	1601.15	50.00
50.10	1601.15	1601.44	1601.72	1602.01	1602.29	1602.58	1602.86	1603.15	1603.43	1603.71	1604.00	50.10
50.20	1604.00	1604.28	1604.57	1604.85	1605.14	1605.42	1605.71	1605.99	1606.28	1606.56	1606.85	50.20
50.30	1606.85	1607.13	1607.42	1607.70	1607.99	1608.27	1608.56	1608.84	1609.13	1609.41	1609.70	50.30
50.40	1609.70	1609.98	1610.27	1610.55	1610.84	1611.12	1611.41	1611.69	1611.98	1612.26	1612.55	50.40
50.50	1612.55	1612.83	1613.12	1613.41	1613.69	1613.98	1614.26	1614.55	1614.83	1615.12	1615.40	50.50
50.60	1615.40	1615.69	1615.97	1616.26	1616.55	1616.83	1617.12	1617.40	1617.69	1617.97	1618.26	50.60
50.70	1618.26	1618.55	1618.83	1619.12	1619.40	1619.69	1619.98	1620.26	1620.55	1620.83	1621.12	50.70
50.80	1621.12	1621.41	1621.69	1621.98	1622.26	1622.55	1622.84	1623.12	1623.41	1623.70	1623.98	50.80
50.90	1623.98	1624.27	1624.55	1624.84	1625.13	1625.41	1625.70	1625.99	1626.27	1626.56	1626.85	50.90
51.00	1626.85	1627.13	1627.42	1627.71	1627.99	1628.28	1628.57	1628.85	1629.14	1629.43	1629.71	51.00
51.10	1629.71	1630.00	1630.29	1630.57	1630.86	1631.15	1631.43	1631.72	1632.01	1632.29	1632.58	51.10
51.20	1632.58	1632.87	1633.16	1633.44	1633.73	1634.02	1634.30	1634.59	1634.88	1635.17	1635.45	51.20
51.30	1635.45	1635.74	1636.03	1636.31	1636.60	1636.89	1637.18	1637.46	1637.75	1638.04	1638.33	51.30
51.40	1638.33	1638.61	1638.90	1639.19	1639.48	1639.76	1640.05	1640.34	1640.63	1640.91	1641.20	51.40
51.50	1641.20	1641.49	1641.78	1642.07	1642.35	1642.64	1642.93	1643.22	1643.51	1643.79	1644.08	51.50
51.60	1644.08	1644.37	1644.66	1644.95	1645.23	1645.52	1645.81	1646.10	1646.39	1646.67	1646.96	51.60
51.70	1646.96	1647.25	1647.54	1647.83	1648.12	1648.40	1648.69	1648.98	1649.27	1649.56	1649.85	51.70
51.80	1649.85	1650.14	1650.42	1650.71	1651.00	1651.29	1651.58	1651.87	1652.16	1652.44	1652.73	51.80
51.90	1652.73	1653.02	1653.31	1653.60	1653.89	1654.18	1654.47	1654.76	1655.04	1655.33	1655.62	51.90
52.00	1655.62	1655.91	1656.20	1656.49	1656.78	1657.07	1657.36	1657.65	1657.94	1658.22	1658.51	52.00
52.10	1658.51	1658.80	1659.09	1659.38	1659.67	1659.96	1660.25	1660.54	1660.83	1661.12	1661.41	52.10
52.20	1661.41	1661.70	1661.99	1662.28	1662.57	1662.86	1663.15	1663.44	1663.73	1664.02	1664.31	52.20
52.30	1664.31	1664.60	1664.88	1665.17	1665.46	1665.75	1666.04	1666.33	1666.62	1666.91	1667.20	52.30
52.40	1667.20	1667.49	1667.77	1668.08	1668.37	1668.66	1668.95	1669.24	1669.53	1669.82	1670.11	52.40
52.50	1670.11	1670.40	1670.69	1670.98	1671.27	1671.56	1671.85	1672.14	1672.43	1672.72	1673.01	52.50
52.60	1673.01	1673.30	1673.59	1673.88	1674.17	1674.47	1674.76	1675.05	1675.34	1675.63	1675.92	52.60
52.70	1675.92	1676.21	1676.50	1676.79	1677.08	1677.37	1677.67	1677.96	1678.25	1678.54	1678.83	52.70
52.80	1678.83	1679.12	1679.41	1679.70	1679.99	1680.29	1680.58	1680.87	1681.16	1681.45	1681.74	52.80
52.90	1681.74	1682.03	1682.33	1682.62	1682.91	1683.20	1683.49	1683.78	1684.07	1684.37	1684.66	52.90
53.00	1684.66	1684.95	1685.24	1685.53	1685.82	1686.12	1686.41	1686.70	1686.99	1687.28	1687.58	53.00
53.10	1687.58	1687.87	1688.16	1688.45	1688.74	1689.04	1689.33	1689.62	1689.91	1690.20	1690.50	53.10
53.20	1690.50	1690.79	1691.08	1691.37	1691.67	1691.96	1692.25	1692.54	1692.84	1693.13	1693.42	53.20
53.30	1693.42	1693.71	1694.01	1694.30	1694.59	1694.88	1695.18	1695.47	1695.76	1696.05	1696.35	53.30
53.40	1696.35	1696.64	1696.93	1697.22	1697.52	1697.81	1698.10	1698.40	1698.69	1698.98	1699.28	53.40
53.50	1699.28	1699.57	1699.86	1700.15	1700.45	1700.74	1701.03	1701.33	1701.62	1701.91	1702.21	53.50
53.60	1702.21	1702.50	1702.79	1703.09	1703.38	1703.67	1703.97	1704.26	1704.55	1704.85	1705.14	53.60
53.70	1705.14	1705.43	1705.73	1706.02	1706.32	1706.61	1706.90	1707.20	1707.49	1707.78	1708.08	53.70
53.80	1708.08	1708.37	1708.67	1708.96	1709.25	1709.55	1709.84	1710.14	1710.43	1710.72	1711.02	53.80
53.90	1711.02	1711.31	1711.61	1711.90	1712.19	1712.49	1712.78	1713.08	1713.37	1713.67	1713.96	53.90
54.00	1713.96	1714.25	1714.55	1714.84	1715.14	1715.43	1715.73	1716.02	1716.32	1716.61	1716.91	54.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. Type J thermocouples extended range—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
54.00	1713.96	1714.25	1714.55	1714.84	1715.14	1715.43	1715.73	1716.02	1716.32	1716.61	1716.91	54.00
54.10	1716.91	1717.20	1717.49	1717.79	1718.08	1718.38	1718.67	1718.97	1719.26	1719.56	1719.85	54.10
54.20	1719.85	1720.15	1720.44	1720.74	1721.03	1721.33	1721.62	1721.92	1722.21	1722.51	1722.80	54.20
54.30	1722.80	1723.10	1723.39	1723.69	1723.98	1724.28	1724.58	1724.87	1725.17	1725.46	1725.76	54.30
54.40	1725.76	1726.05	1726.35	1726.64	1726.94	1727.23	1727.53	1727.83	1728.12	1728.42	1728.71	54.40
54.50	1728.71	1729.01	1729.30	1729.60	1729.90	1730.19	1730.49	1730.78	1731.08	1731.38	1731.67	54.50
54.60	1731.67	1731.97	1732.26	1732.56	1732.86	1733.15	1733.45	1733.74	1734.04	1734.34	1734.63	54.60
54.70	1734.63	1734.93	1735.22	1735.52	1735.82	1736.11	1736.41	1736.71	1737.00	1737.30	1737.60	54.70
54.80	1737.60	1737.89	1738.19	1738.49	1738.78	1739.08	1739.38	1739.67	1739.97	1740.27	1740.56	54.80
54.90	1740.56	1740.86	1741.16	1741.45	1741.75	1742.05	1742.34	1742.64	1742.94	1743.23	1743.53	54.90
55.00	1743.53	1743.83	1744.13	1744.42	1744.72	1745.02	1745.31	1745.61	1745.91	1746.21	1746.50	55.00
55.10	1746.50	1746.80	1747.10	1747.40	1747.69	1747.99	1748.29	1748.59	1748.88	1749.18	1749.48	55.10
55.20	1749.48	1749.78	1750.07	1750.37	1750.67	1750.97	1751.26	1751.56	1751.86	1752.16	1752.45	55.20
55.30	1752.45	1752.75	1753.05	1753.35	1753.65	1753.94	1754.24	1754.54	1754.84	1755.14	1755.43	55.30
55.40	1755.43	1755.73	1756.03	1756.33	1756.63	1756.93	1757.22	1757.52	1757.82	1758.12	1758.42	55.40
55.50	1758.42	1758.71	1759.01	1759.31	1759.61	1759.91	1760.21	1760.51	1760.80	1761.10	1761.40	55.50
55.60	1761.40	1761.70	1762.00	1762.30	1762.60	1762.89	1763.19	1763.49	1763.79	1764.09	1764.39	55.60
55.70	1764.39	1764.69	1764.99	1765.29	1765.58	1765.88	1766.18	1766.48	1766.78	1767.08	1767.38	55.70
55.80	1767.38	1767.68	1767.98	1768.28	1768.57	1768.87	1769.17	1769.47	1769.77	1770.07	1770.37	55.80
55.90	1770.37	1770.67	1770.97	1771.27	1771.57	1771.87	1772.17	1772.47	1772.77	1773.07	1773.37	55.90
56.00	1773.37	1773.67	1773.96	1774.26	1774.56	1774.86	1775.16	1775.46	1775.76	1776.06	1776.36	56.00
56.10	1776.36	1776.66	1776.96	1777.26	1777.56	1777.86	1778.16	1778.46	1778.76	1779.06	1779.36	56.10
56.20	1779.36	1779.66	1779.96	1780.26	1780.56	1780.86	1781.16	1781.46	1781.76	1782.06	1782.36	56.20
56.30	1782.36	1782.67	1782.97	1783.27	1783.57	1783.87	1784.17	1784.47	1784.77	1785.07	1785.37	56.30
56.40	1785.37	1785.67	1785.97	1786.27	1786.57	1786.87	1787.17	1787.47	1787.78	1788.08	1788.38	56.40
56.50	1788.38	1788.68	1788.98	1789.28	1789.58	1789.88	1790.18	1790.48	1790.78	1791.09	1791.39	56.50
56.60	1791.39	1791.69	1791.99	1792.29	1792.59	1792.89	1793.19	1793.49	1793.80	1794.10	1794.40	56.60
56.70	1794.40	1794.70	1795.00	1795.30	1795.60	1795.91	1796.21	1796.51	1796.81	1797.11	1797.41	56.70
56.80	1797.41	1797.71	1798.02	1798.32	1798.62	1798.92	1799.22	1799.52	1799.83	1800.13	1800.43	56.80
56.90	1800.43	1800.73	1801.03	1801.33	1801.64	1801.94	1802.24	1802.54	1802.84	1803.15	1803.45	56.90
57.00	1803.45	1803.75	1804.05	1804.35	1804.66	1804.96	1805.26	1805.56	1805.87	1806.17	1806.47	57.00
57.10	1806.47	1806.77	1807.07	1807.38	1807.68	1807.98	1808.28	1808.59	1808.89	1809.19	1809.49	57.10
57.20	1809.49	1809.80	1810.10	1810.40	1810.70	1811.01	1811.31	1811.61	1811.91	1812.22	1812.52	57.20
57.30	1812.52	1812.82	1813.12	1813.43	1813.73	1814.03	1814.34	1814.64	1814.94	1815.24	1815.55	57.30
57.40	1815.55	1815.85	1816.15	1816.46	1816.76	1817.06	1817.37	1817.67	1817.97	1818.27	1818.58	57.40
57.50	1818.58	1818.88	1819.18	1819.49	1819.79	1820.09	1820.40	1820.70	1821.00	1821.31	1821.61	57.50
57.60	1821.61	1821.91	1822.22	1822.52	1822.82	1823.13	1823.43	1823.73	1824.04	1824.34	1824.64	57.60
57.70	1824.64	1824.95	1825.25	1825.56	1825.86	1826.16	1826.47	1826.77	1827.07	1827.38	1827.68	57.70
57.80	1827.68	1827.99	1828.29	1828.59	1828.89	1829.20	1829.50	1829.81	1830.11	1830.42	1830.72	57.80
57.90	1830.72	1831.02	1831.33	1831.63	1831.94	1832.24	1832.54	1832.85	1833.15	1833.46	1833.76	57.90
58.00	1833.76	1834.07	1834.37	1834.67	1834.98	1835.28	1835.59	1835.89	1836.20	1836.50	1836.80	58.00
58.10	1836.80	1837.11	1837.41	1837.72	1838.02	1838.33	1838.63	1838.94	1839.24	1839.54	1839.85	58.10
58.20	1839.85	1840.15	1840.46	1840.76	1841.07	1841.37	1841.68	1841.98	1842.29	1842.59	1842.90	58.20
58.30	1842.90	1843.20	1843.51	1843.81	1844.12	1844.42	1844.73	1845.03	1845.34	1845.64	1845.95	58.30
58.40	1845.95	1846.25	1846.56	1846.86	1847.17	1847.47	1847.78	1848.08	1848.39	1848.69	1849.00	58.40
58.50	1849.00	1849.30	1849.61	1849.91	1850.22	1850.52	1850.83	1851.13	1851.44	1851.74	1852.05	58.50
58.60	1852.05	1852.35	1852.66	1852.97	1853.27	1853.58	1853.88	1854.19	1854.49	1854.80	1855.10	58.60
58.70	1855.10	1855.41	1855.72	1856.02	1856.33	1856.63	1856.94	1857.24	1857.55	1857.86	1858.16	58.70
58.80	1858.16	1858.47	1858.77	1859.08	1859.38	1859.69	1860.00	1860.30	1860.61	1860.91	1861.22	58.80
58.90	1861.22	1861.53	1861.83	1862.14	1862.44	1862.75	1863.06	1863.36	1863.67	1863.97	1864.28	58.90
59.00	1864.28	1864.59	1864.89	1865.20	1865.50	1865.81	1866.12	1866.42	1866.73	1867.04	1867.34	59.00
59.10	1867.34	1867.65	1867.95	1868.26	1868.57	1868.87	1869.18	1869.49	1869.79	1870.10	1870.41	59.10
59.20	1870.41	1870.71	1871.02	1871.33	1871.63	1871.94	1872.24	1872.55	1872.86	1873.16	1873.47	59.20
59.30	1873.47	1873.78	1874.08	1874.39	1874.70	1875.00	1875.31	1875.62	1875.92	1876.23	1876.54	59.30
59.40	1876.54	1876.85	1877.15	1877.46	1877.77	1878.07	1878.38	1878.69	1878.99	1879.30	1879.61	59.40
59.50	1879.61	1879.91	1880.22	1880.53	1880.84	1881.14	1881.45	1881.76	1882.06	1882.37	1882.68	59.50
59.60	1882.68	1882.98	1883.29	1883.60	1883.91	1884.21	1884.52	1884.83	1885.14	1885.44	1885.75	59.60
59.70	1885.75	1886.06	1886.36	1886.67	1886.98	1887.29	1887.59	1887.90	1888.21	1888.52	1888.82	59.70
59.80	1888.82	1889.13	1889.44	1889.75	1890.05	1890.36	1890.67	1890.98	1891.28	1891.59	1891.90	59.80
59.90	1891.90	1892.21	1892.51	1892.82	1893.13	1893.44	1893.74	1894.05	1894.36	1894.67	1894.98	59.90
60.00	1894.98	1895.28	1895.59	1895.90	1896.21	1896.51	1896.82	1897.13	1897.44	1897.75	1898.05	60.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.2. *Type J thermocouples extended range—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
60.00	1894.98	1895.28	1895.59	1895.90	1896.21	1896.51	1896.82	1897.13	1897.44	1897.75	1898.05	60.00
60.10	1898.05	1898.36	1898.67	1898.98	1899.28	1899.59	1899.90	1900.21	1900.52	1900.82	1901.13	60.10
60.20	1901.13	1901.44	1901.75	1902.06	1902.37	1902.67	1902.98	1903.29	1903.60	1903.91	1904.21	60.20
60.30	1904.21	1904.52	1904.83	1905.14	1905.45	1905.75	1906.06	1906.37	1906.68	1906.99	1907.30	60.30
60.40	1907.30	1907.60	1907.91	1908.22	1908.53	1908.84	1909.15	1909.45	1909.76	1910.07	1910.38	60.40
60.50	1910.38	1910.69	1911.00	1911.31	1911.61	1911.92	1912.23	1912.54	1912.85	1913.16	1913.46	60.50
60.60	1913.46	1913.77	1914.08	1914.39	1914.70	1915.01	1915.32	1915.63	1915.93	1916.24	1916.55	60.60
60.70	1916.55	1916.86	1917.17	1917.48	1917.79	1918.09	1918.40	1918.71	1919.02	1919.33	1919.64	60.70
60.80	1919.64	1919.95	1920.26	1920.57	1920.87	1921.18	1921.49	1921.80	1922.11	1922.42	1922.73	60.80
60.90	1922.73	1923.04	1923.35	1923.65	1923.96	1924.27	1924.58	1924.89	1925.20	1925.51	1925.82	60.90
61.00	1925.82	1926.13	1926.44	1926.74	1927.05	1927.36	1927.67	1927.98	1928.29	1928.60	1928.91	61.00
61.10	1928.91	1929.22	1929.53	1929.84	1930.15	1930.45	1930.76	1931.07	1931.38	1931.69	1932.00	61.10
61.20	1932.00	1932.31	1932.62	1932.93	1933.24	1933.55	1933.86	1934.17	1934.48	1934.78	1935.09	61.20
61.30	1935.09	1935.40	1935.71	1936.02	1936.33	1936.64	1936.95	1937.26	1937.57	1937.88	1938.19	61.30
61.40	1938.19	1938.50	1938.81	1939.12	1939.43	1939.74	1940.05	1940.36	1940.67	1940.97	1941.28	61.40
61.50	1941.28	1941.59	1941.90	1942.21	1942.52	1942.83	1943.14	1943.45	1943.76	1944.07	1944.38	61.50
61.60	1944.38	1944.69	1945.00	1945.31	1945.62	1945.93	1946.24	1946.55	1946.86	1947.17	1947.48	61.60
61.70	1947.48	1947.79	1948.10	1948.41	1948.72	1949.03	1949.34	1949.65	1949.96	1950.27	1950.58	61.70
61.80	1950.58	1950.89	1951.20	1951.51	1951.82	1952.13	1952.44	1952.75	1953.06	1953.37	1953.68	61.80
61.90	1953.68	1953.99	1954.30	1954.61	1954.92	1955.23	1955.54	1955.85	1956.16	1956.47	1956.78	61.90
62.00	1956.78	1957.09	1957.40	1957.71	1958.02	1958.33	1958.64	1958.95	1959.26	1959.57	1959.88	62.00
62.10	1959.88	1960.19	1960.50	1960.81	1961.12	1961.43	1961.74	1962.05	1962.36	1962.67	1962.98	62.10
62.20	1962.98	1963.29	1963.60	1963.91	1964.22	1964.53	1964.84	1965.15	1965.46	1965.77	1966.08	62.20
62.30	1966.08	1966.39	1966.70	1967.01	1967.32	1967.63	1967.94	1968.25	1968.57	1968.88	1969.19	62.30
62.40	1969.19	1969.50	1969.81	1970.12	1970.43	1970.74	1971.05	1971.36	1971.67	1971.98	1972.29	62.40
62.50	1972.29	1972.60	1972.91	1973.22	1973.53	1973.84	1974.15	1974.46	1974.77	1975.08	1975.40	62.50
62.60	1975.40	1975.71	1976.02	1976.33	1976.64	1976.95	1977.26	1977.57	1977.88	1978.19	1978.50	62.60
62.70	1978.50	1978.81	1979.12	1979.43	1979.74	1980.05	1980.37	1980.68	1980.99	1981.30	1981.61	62.70
62.80	1981.61	1981.92	1982.23	1982.54	1982.85	1983.16	1983.47	1983.78	1984.09	1984.40	1984.72	62.80
62.90	1984.72	1985.03	1985.34	1985.65	1985.96	1986.27	1986.58	1986.89	1987.20	1987.51	1987.82	62.90
63.00	1987.82	1988.13	1988.44	1988.76	1989.07	1989.38	1989.69	1990.00	1990.31	1990.62	1990.93	63.00
63.10	1990.93	1991.24	1991.55	1991.86	1992.18	1992.49	1992.80	1993.11	1993.42	1993.73	1994.04	63.10
63.20	1994.04	1994.35	1994.66	1994.97	1995.28	1995.60	1995.91	1996.22	1996.53	1996.84	1997.15	63.20
63.30	1997.15	1997.46	1997.77	1998.08	1998.39	1998.71	1999.02	1999.33	1999.64	1999.95	2000.26	63.30
63.40	2000.26	2000.57	2000.88	2001.19	2001.50	2001.82	2002.13	2002.44	2002.75	2003.06	2003.37	63.40
63.50	2003.37	2003.68	2003.99	2004.30	2004.62	2004.93	2005.24	2005.55	2005.86	2006.17	2006.48	63.50
63.60	2006.48	2006.79	2007.11	2007.42	2007.73	2008.04	2008.35	2008.66	2008.97	2009.28	2009.59	63.60
63.70	2009.59	2009.91	2010.22	2010.53	2010.84	2011.15	2011.46	2011.77	2012.08	2012.40	2012.71	63.70
63.80	2012.71	2013.02	2013.33	2013.64	2013.95	2014.26	2014.57	2014.89	2015.20	2015.51	2015.82	63.80
63.90	2015.82	2016.13	2016.44	2016.75	2017.07	2017.38	2017.69	2018.00	2018.31	2018.62	2018.93	63.90
64.00	2018.93	2019.24	2019.56	2019.87	2020.18	2020.49	2020.80	2021.11	2021.42	2021.74	2022.05	64.00
64.10	2022.05	2022.36	2022.67	2022.98	2023.29	2023.60	2023.92	2024.23	2024.54	2024.85	2025.16	64.10
64.20	2025.16	2025.47	2025.78	2026.10	2026.41	2026.72	2027.03	2027.34	2027.65	2027.96	2028.28	64.20
64.30	2028.28	2028.59	2028.90	2029.21	2029.52	2029.83	2030.14	2030.46	2030.77	2031.08	2031.39	64.30
64.40	2031.39	2031.70	2032.01	2032.33	2032.64	2032.95	2033.26	2033.57	2033.88	2034.19	2034.51	64.40
64.50	2034.51	2034.82	2035.13	2035.44	2035.75	2036.06	2036.38	2036.69	2037.00	2037.31	2037.62	64.50
64.60	2037.62	2037.93	2038.25	2038.56	2038.87	2039.18	2039.49	2039.80	2040.12	2040.43	2040.74	64.60
64.70	2040.74	2041.05	2041.36	2041.67	2041.98	2042.30	2042.61	2042.92	2043.23	2043.54	2043.85	64.70
64.80	2043.85	2044.17	2044.48	2044.79	2045.10	2045.41	2045.72	2046.04	2046.35	2046.66	2046.97	64.80
64.90	2046.97	2047.28	2047.60	2047.91	2048.22	2048.53	2048.84	2049.15	2049.47	2049.78	2050.09	64.90
65.00	2050.09	2050.40	2050.71	2051.02	2051.34	2051.65	2051.96	2052.27	2052.58	2052.89	2053.21	65.00
65.10	2053.21	2053.52	2053.83	2054.14	2054.45	2054.77	2055.08	2055.39	2055.70	2056.01	2056.32	65.10
65.20	2056.32	2056.64	2056.95	2057.26	2057.57	2057.88	2058.20	2058.51	2058.82	2059.13	2059.44	65.20
65.30	2059.44	2059.75	2060.07	2060.38	2060.69	2061.00	2061.31	2061.63	2061.94	2062.25	2062.56	65.30
65.40	2062.56	2062.87	2063.19	2063.50	2063.81	2064.12	2064.43	2064.74	2065.06	2065.37	2065.68	65.40
65.50	2065.68	2065.99	2066.30	2066.62	2066.93	2067.24	2067.55	2067.86	2068.18	2068.49	2068.80	65.50
65.60	2068.80	2069.11	2069.42	2069.74	2070.05	2070.36	2070.67	2070.98	2071.30	2071.61	2071.92	65.60
65.70	2071.92	2072.23	2072.54	2072.86	2073.17	2073.48	2073.79	2074.10	2074.42	2074.73	2075.04	65.70
65.80	2075.04	2075.35	2075.66	2075.98	2076.29	2076.60	2076.91	2077.22	2077.54	2077.85	2078.16	65.80
65.90	2078.16	2078.47	2078.78	2079.10	2079.41	2079.72	2080.03	2080.34	2080.66	2080.97	2081.28	65.90
66.00	2081.28	2081.59	2081.90	2082.22	2082.53	2082.84	2083.15	2083.47	2083.78	2084.09	2084.40	66.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE 6.2.2. *Type J thermocouples extended range—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
66.00	2081.28	2081.59	2081.90	2082.22	2082.53	2082.84	2083.15	2083.47	2083.78	2084.09	2084.40	66.00
66.10	2084.40	2084.71	2085.03	2085.34	2085.65	2085.96	2086.27	2086.59	2086.90	2087.21	2087.52	66.10
66.20	2087.52	2087.84	2088.15	2088.46	2088.77	2089.08	2089.40	2089.71	2090.02	2090.33	2090.65	66.20
66.30	2090.65	2090.96	2091.27	2091.58	2091.89	2092.21	2092.52	2092.83	2093.14	2093.46	2093.77	66.30
66.40	2093.77	2094.08	2094.39	2094.70	2095.02	2095.33	2095.64	2095.95	2096.27	2096.58	2096.89	66.40
66.50	2096.89	2097.20	2097.51	2097.83	2098.14	2098.45	2098.76	2099.08	2099.39	2099.70	2100.01	66.50
66.60	2100.01	2100.33	2100.64	2100.95	2101.26	2101.57	2101.89	2102.20	2102.51	2102.82	2103.14	66.60
66.70	2103.14	2103.45	2103.76	2104.07	2104.39	2104.70	2105.01	2105.32	2105.64	2105.95	2106.26	66.70
66.80	2106.26	2106.57	2106.89	2107.20	2107.51	2107.82	2108.13	2108.45	2108.76	2109.07	2109.38	66.80
66.90	2109.38	2109.70	2110.01	2110.32	2110.63	2110.95	2111.26	2111.57	2111.88	2112.20	2112.51	66.90
67.00	2112.51	2112.82	2113.13	2113.45	2113.76	2114.07	2114.38	2114.70	2115.01	2115.32	2115.63	67.00
67.10	2115.63	2115.95	2116.26	2116.57	2116.88	2117.20	2117.51	2117.82	2118.14	2118.45	2118.76	67.10
67.20	2118.76	2119.07	2119.39	2119.70	2120.01	2120.32	2120.64	2120.95	2121.26	2121.57	2121.89	67.20
67.30	2121.89	2122.20	2122.51	2122.82	2123.14	2123.45	2123.76	2124.08	2124.39	2124.70	2125.01	67.30
67.40	2125.01	2125.33	2125.64	2125.95	2126.26	2126.58	2126.89	2127.20	2127.52	2127.83	2128.14	67.40
67.50	2128.14	2128.45	2128.77	2129.08	2129.39	2129.71	2130.02	2130.33	2130.64	2130.96	2131.27	67.50
67.60	2131.27	2131.58	2131.89	2132.21	2132.52	2132.83	2133.15	2133.46	2133.77	2134.08	2134.40	67.60
67.70	2134.40	2134.71	2135.02	2135.34	2135.65	2135.96	2136.28	2136.59	2136.90	2137.21	2137.53	67.70
67.80	2137.53	2137.84	2138.15	2138.47	2138.78	2139.09	2139.41	2139.72	2140.03	2140.34	2140.66	67.80
67.90	2140.66	2140.97	2141.28	2141.60	2141.91	2142.22	2142.54	2142.85	2143.16	2143.48	2143.79	67.90
68.00	2143.79	2144.10	2144.41	2144.73	2145.04	2145.35	2145.67	2145.98	2146.29	2146.61	2146.92	68.00
68.10	2146.92	2147.23	2147.55	2147.86	2148.17	2148.49	2148.80	2149.11	2149.43	2149.74	2150.05	68.10
68.20	2150.05	2150.37	2150.68	2150.99	2151.31	2151.62	2151.93	2152.25	2152.56	2152.87	2153.19	68.20
68.30	2153.19	2153.50	2153.81	2154.13	2154.44	2154.75	2155.07	2155.38	2155.69	2156.01	2156.32	68.30
68.40	2156.32	2156.63	2156.95	2157.26	2157.57	2157.89	2158.20	2158.51	2158.83	2159.14	2159.45	68.40
68.50	2159.45	2159.77	2160.08	2160.40	2160.71	2161.02	2161.34	2161.65	2161.96	2162.28	2162.59	68.50
68.60	2162.59	2162.90	2163.22	2163.53	2163.85	2164.16	2164.47	2164.79	2165.10	2165.41	2165.73	68.60
68.70	2165.73	2166.04	2166.36	2166.67	2166.98	2167.30	2167.61	2167.92	2168.24	2168.55	2168.87	68.70
68.80	2168.87	2169.18	2169.49	2169.81	2170.12	2170.44	2170.75	2171.06	2171.38	2171.69	2172.00	68.80
68.90	2172.00	2172.32	2172.63	2172.95	2173.26	2173.57	2173.89	2174.20	2174.52	2174.83	2175.15	68.90
69.00	2175.15	2175.46	2175.77	2176.09	2176.40	2176.72	2177.03	2177.34	2177.66	2177.97	2178.29	69.00
69.10	2178.29	2178.60	2178.92	2179.23	2179.54	2179.86	2180.17	2180.49	2180.80	2181.12	2181.43	69.10
69.20	2181.43	2181.74	2182.06	2182.37	2182.69	2183.00	2183.32	2183.63	2183.94	2184.26	2184.57	69.20
69.30	2184.57	2184.89	2185.20	2185.52	2185.83	2186.15	2186.46	2186.78	2187.09	2187.40	2187.72	69.30
69.40	2187.72	2188.03	2188.35	2188.66	2188.98	2189.29	2189.61	2189.92	2190.24	2190.55	2190.87	69.40
69.50	2190.87	2191.18	2191.50	2191.81								69.50
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A6.2.3. *Type J thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges (°C). The expansion is of the form*
 $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ *where E is in microvolts and T is in degrees Celsius*

Temperature Range (C°)	a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (C°)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
-200 to 0	.....		1, 8843850	-2	-1, 2029733	-6	-2, 5278593	-10	-2, 5849263	-14	-.4 to .5
-200 to 760	.....		2, 1155170	-2	-3, 3513149	-7	1, 2443997	-11	-1, 5227150	-16	-6 to 7
-200 to 1200	.....		2, 1676850	-2	-2, 1844464	-7	3, 9094347	-12	-2, 4303017	-17	-14 to 10
- 20 to 500	.....		1, 9745056	-2	-1, 8094256	-7	7, 8777919	-12	-1, 1897222	-16	-.07 to .06
0 to 400	.....		1, 9750953	-2	-1, 8542600	-7	8, 3683958	-12	-1, 3280568	-16	-.03 to .05
0 to 760	.....		1, 9323799	-2	-1, 0306020	-7	3, 7084018	-12	-5, 1031937	-17	-.9 to .7
0 to 1200	.....		1, 8134974	-2	-5, 6495930	-8	-2, 4644023	-12	2, 1141718	-17	-3 to 4
400 to 760	9, 2808351	+1	5, 4463817	-3	6, 5254537	-7	-1, 3987013	-11	9, 9364476	-17	-.03 to .03
400 to 1200	-1, 1075293	+2	2, 8651303	-2	-2, 9758175	-7	2, 5945419	-12	-4, 9012035	-18	-1.3 to 1.6
600 to 760	1, 8020713	+2	-4, 5284199	-3	1, 0769294	-6	-2, 1962321	-11	1, 5521511	-16	-.001 to .001
760 to 1200	-6, 3828680	+2	7, 4068749	-2	-1, 7177773	-6	2, 1771293	-11	-9, 9502571	-17	-.15 to .11
II. Cubic Equation											
-200 to 0	.....		2, 1505558	-2	7, 0760633	-7	1, 4905372	-10	.....	..	-1.2 to 1.2
-200 to 760	.....		2, 1515056	-2	-2, 0083005	-7	2, 7148959	-12	.....	..	-17 to 10
-200 to 1200	.....		2, 0978541	-2	-1, 2232172	-7	9, 9773144	-13	.....	..	-27 to 7
- 20 to 500	.....		1, 9283042	-2	-8, 0675605	-8	1, 6027847	-12	.....	..	-.8 to .7
0 to 400	.....		1, 9473887	-2	-1, 1226744	-7	2, 7239574	-12	.....	..	-.3 to .4
0 to 760	.....		1, 8533724	-2	4, 2760262	-9	-5, 3564407	-13	.....	..	-1.7 to 2.3
0 to 1200	.....		1, 9503772	-2	-5, 9445161	-8	3, 8077327	-13	.....	..	-5 to 6
400 to 760	-4, 8968376	+0	1, 8210534	-2	3, 9107118	-8	-1, 1248415	-12	.....	..	-.17 to .17
400 to 1200	-9, 5029593	+1	2, 7038308	-2	-2, 3904271	-7	1, 6991082	-12	.....	..	-1.5 to 1.8
600 to 760	-1, 3840517	+2	2, 9282700	-2	-2, 6481733	-7	1, 6363524	-12	.....	..	-.012 to .011
760 to 1200	3, 0173741	+2	5, 2561347	-3	1, 5285291	-7	-6, 1293733	-13	.....	..	-.5 to .5
III. Quadratic Equation											
-200 to 0	.....		1, 7220554	-2	-9, 7062857	-7	.....	..	.....	..	-.4 to 3
-200 to 760	.....		2, 0067076	-2	-5, 8531132	-8	.....	..	.....	..	-.40 to 7
-200 to 1200	.....		1, 9101790	-2	-2, 9457523	-8	.....	..	.....	..	-.50 to 15
- 20 to 500	.....		1, 8761619	-2	-1, 9620173	-8	.....	..	.....	..	-1.3 to 1.8
0 to 400	.....		1, 8912421	-2	-2, 9795010	-8	.....	..	.....	..	-.9 to 1.4
0 to 760	.....		1, 8958492	-2	-2, 7558559	-8	.....	..	.....	..	-3 to 3
0 to 1200	.....		1, 8726144	-2	-2, 3056976	-8	.....	..	.....	..	-10 to 10
400 to 760	-4, 0195579	+1	2, 1657731	-2	-7, 0116467	-8	.....	..	.....	..	-.4 to .6
400 to 1200	3, 6253972	+1	1, 7074216	-2	-6, 2082442	-9	.....	..	.....	..	-.7 to 7
600 to 760	-4, 9827896	+1	2, 2229648	-2	-7, 8370423	-8	.....	..	.....	..	-.06 to .07
760 to 1200	1, 9684494	+2	1, 1000534	-2	4, 9405799	-8	.....	..	.....	..	-.7 to .6

A7. Supplementary Data for Type K—*Nickel*—Chromium Alloy Versus *Nickel*—Aluminum Alloy Thermocouples

A7.1. Data for Voltage as a Function of Temperature

The full precision coefficients given in the main text are used to generate the voltage as a function of temperature data given in tables A7.1.1 and A7.1.2. Table A7.1.1 presents the data in degrees Celsius from -270°C to 1372°C while table A7.1.2 presents the data in degrees Fahrenheit from -454°F to 2500°F . Table A7.1.3 contains quadratic, cubic, and quartic approximations to the data as a function of temperature in selected temperature ranges. The error range given in the table is the difference between the voltage as obtained from the full precision coefficients from the text and the respective reduced order approximations. The last entries in the cubic and quadratic groupings of table A7.1.3 represent variable reference junction corrections in the 0 to 50°C temperature range. In the narrower temperature range near room temperatures, 20 to 25°C , the error range for the given *quadratic* equation is smaller than that listed in the last column: $\pm 0.2\ \mu\text{V}$.

TABLE A7.1.1. *Type K thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C*

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-270	-6.458											-270
-260	-6.441	-6.444	-6.446	-6.448	-6.450	-6.452	-6.453	-6.455	-6.456	-6.457	-6.458	-260
-250	-6.404	-6.408	-6.413	-6.417	-6.421	-6.425	-6.429	-6.432	-6.435	-6.438	-6.441	-250
-240	-6.344	-6.351	-6.358	-6.364	-6.371	-6.377	-6.382	-6.388	-6.394	-6.399	-6.404	-240
-230	-6.262	-6.271	-6.280	-6.289	-6.297	-6.306	-6.314	-6.322	-6.329	-6.337	-6.344	-230
-220	-6.158	-6.170	-6.181	-6.192	-6.202	-6.213	-6.223	-6.233	-6.243	-6.253	-6.262	-220
-210	-6.035	-6.048	-6.061	-6.074	-6.087	-6.099	-6.111	-6.123	-6.135	-6.147	-6.158	-210
-200	-5.891	-5.907	-5.922	-5.936	-5.951	-5.965	-5.980	-5.994	-6.007	-6.021	-6.035	-200
-190	-5.730	-5.747	-5.763	-5.780	-5.796	-5.813	-5.829	-5.845	-5.860	-5.876	-5.891	-190
-180	-5.550	-5.569	-5.587	-5.606	-5.624	-5.642	-5.660	-5.678	-5.695	-5.712	-5.730	-180
-170	-5.354	-5.374	-5.394	-5.414	-5.434	-5.454	-5.474	-5.493	-5.512	-5.531	-5.550	-170
-160	-5.141	-5.163	-5.185	-5.207	-5.228	-5.249	-5.271	-5.292	-5.313	-5.333	-5.354	-160
-150	-4.912	-4.936	-4.959	-4.983	-5.006	-5.029	-5.051	-5.074	-5.097	-5.119	-5.141	-150
-140	-4.669	-4.694	-4.719	-4.743	-4.768	-4.792	-4.817	-4.841	-4.865	-4.889	-4.912	-140
-130	-4.410	-4.437	-4.463	-4.489	-4.515	-4.541	-4.567	-4.593	-4.618	-4.644	-4.669	-130
-120	-4.138	-4.166	-4.193	-4.221	-4.248	-4.276	-4.303	-4.330	-4.357	-4.384	-4.410	-120
-110	-3.852	-3.881	-3.910	-3.939	-3.968	-3.997	-4.025	-4.053	-4.082	-4.110	-4.138	-110
-100	-3.553	-3.584	-3.614	-3.644	-3.674	-3.704	-3.734	-3.764	-3.793	-3.823	-3.852	-100
-90	-3.242	-3.274	-3.305	-3.337	-3.368	-3.399	-3.430	-3.461	-3.492	-3.523	-3.553	-90
-80	-2.920	-2.953	-2.985	-3.018	-3.050	-3.082	-3.115	-3.147	-3.179	-3.211	-3.242	-80
-70	-2.586	-2.620	-2.654	-2.687	-2.721	-2.754	-2.788	-2.821	-2.854	-2.887	-2.920	-70
-60	-2.243	-2.277	-2.312	-2.347	-2.381	-2.416	-2.450	-2.484	-2.518	-2.552	-2.586	-60
-50	-1.889	-1.925	-1.961	-1.996	-2.032	-2.067	-2.102	-2.137	-2.173	-2.208	-2.243	-50
-40	-1.527	-1.563	-1.600	-1.636	-1.673	-1.709	-1.745	-1.781	-1.817	-1.853	-1.889	-40
-30	-1.156	-1.193	-1.231	-1.268	-1.305	-1.342	-1.379	-1.416	-1.453	-1.490	-1.527	-30
-20	-0.777	-0.816	-0.854	-0.892	-0.930	-0.968	-1.005	-1.043	-1.081	-1.118	-1.156	-20
-10	-0.392	-0.431	-0.469	-0.508	-0.547	-0.585	-0.624	-0.662	-0.701	-0.739	-0.777	-10
- 0	0.000	-0.039	-0.079	-0.118	-0.157	-0.197	-0.236	-0.275	-0.314	-0.353	-0.392	- 0
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A7.1.1. Type K thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C —Continued

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	0.000	0.039	0.079	0.119	0.158	0.198	0.238	0.277	0.317	0.357	0.397	0
10	0.397	0.437	0.477	0.517	0.557	0.597	0.637	0.677	0.718	0.758	0.798	10
20	0.798	0.838	0.879	0.919	0.960	1.000	1.041	1.081	1.122	1.162	1.203	20
30	1.203	1.244	1.285	1.325	1.366	1.407	1.448	1.489	1.529	1.570	1.611	30
40	1.611	1.652	1.693	1.734	1.776	1.817	1.858	1.899	1.940	1.981	2.022	40
50	2.022	2.064	2.105	2.146	2.188	2.229	2.270	2.312	2.353	2.394	2.436	50
60	2.436	2.477	2.519	2.560	2.601	2.643	2.684	2.726	2.767	2.809	2.850	60
70	2.850	2.892	2.933	2.975	3.016	3.058	3.100	3.141	3.183	3.224	3.266	70
80	3.266	3.307	3.349	3.390	3.432	3.473	3.515	3.556	3.598	3.639	3.681	80
90	3.681	3.722	3.764	3.805	3.847	3.888	3.930	3.971	4.012	4.054	4.095	90
100	4.095	4.137	4.178	4.219	4.261	4.302	4.343	4.384	4.426	4.467	4.508	100
110	4.508	4.549	4.590	4.632	4.673	4.714	4.755	4.796	4.837	4.878	4.919	110
120	4.919	4.960	5.001	5.042	5.083	5.124	5.164	5.205	5.246	5.287	5.327	120
130	5.327	5.368	5.409	5.450	5.490	5.531	5.571	5.612	5.652	5.693	5.733	130
140	5.733	5.774	5.814	5.855	5.895	5.936	5.976	6.016	6.057	6.097	6.137	140
150	6.137	6.177	6.218	6.258	6.298	6.338	6.378	6.419	6.459	6.499	6.539	150
160	6.539	6.579	6.619	6.659	6.699	6.739	6.779	6.819	6.859	6.899	6.939	160
170	6.939	6.979	7.019	7.059	7.099	7.139	7.179	7.219	7.259	7.299	7.338	170
180	7.338	7.378	7.418	7.458	7.498	7.538	7.578	7.618	7.658	7.697	7.737	180
190	7.737	7.777	7.817	7.857	7.897	7.937	7.977	8.017	8.057	8.097	8.137	190
200	8.137	8.177	8.216	8.256	8.296	8.336	8.376	8.416	8.456	8.497	8.537	200
210	8.537	8.577	8.617	8.657	8.697	8.737	8.777	8.817	8.857	8.898	8.938	210
220	8.938	8.978	9.018	9.058	9.099	9.139	9.179	9.220	9.260	9.300	9.341	220
230	9.341	9.381	9.421	9.462	9.502	9.543	9.583	9.624	9.664	9.705	9.745	230
240	9.745	9.786	9.826	9.867	9.907	9.948	9.989	10.029	10.070	10.111	10.151	240
250	10.151	10.192	10.233	10.274	10.315	10.355	10.396	10.437	10.478	10.519	10.560	250
260	10.560	10.600	10.641	10.682	10.723	10.764	10.805	10.846	10.887	10.928	10.969	260
270	10.969	11.010	11.051	11.093	11.134	11.175	11.216	11.257	11.298	11.339	11.381	270
280	11.381	11.422	11.463	11.504	11.546	11.587	11.628	11.669	11.711	11.752	11.793	280
290	11.793	11.835	11.876	11.918	11.959	12.000	12.042	12.083	12.125	12.166	12.207	290
300	12.207	12.249	12.290	12.332	12.373	12.415	12.456	12.498	12.539	12.581	12.623	300
310	12.623	12.664	12.706	12.747	12.789	12.831	12.872	12.914	12.955	12.997	13.039	310
320	13.039	13.080	13.122	13.164	13.205	13.247	13.289	13.331	13.372	13.414	13.456	320
330	13.456	13.497	13.539	13.581	13.623	13.665	13.706	13.748	13.790	13.832	13.874	330
340	13.874	13.915	13.957	13.999	14.041	14.083	14.125	14.167	14.208	14.250	14.292	340
350	14.292	14.334	14.376	14.418	14.460	14.502	14.544	14.586	14.628	14.670	14.712	350
360	14.712	14.754	14.796	14.838	14.880	14.922	14.964	15.006	15.048	15.090	15.132	360
370	15.132	15.174	15.216	15.258	15.300	15.342	15.384	15.426	15.468	15.510	15.552	370
380	15.552	15.594	15.636	15.679	15.721	15.763	15.805	15.847	15.889	15.931	15.974	380
390	15.974	16.016	16.058	16.100	16.142	16.184	16.227	16.269	16.311	16.353	16.395	390
400	16.395	16.438	16.480	16.522	16.564	16.607	16.649	16.691	16.733	16.776	16.818	400
410	16.818	16.860	16.902	16.945	16.987	17.029	17.072	17.114	17.156	17.199	17.241	410
420	17.241	17.283	17.326	17.368	17.410	17.453	17.495	17.537	17.580	17.622	17.664	420
430	17.664	17.707	17.749	17.792	17.834	17.876	17.919	17.961	18.004	18.046	18.088	430
440	18.088	18.131	18.173	18.216	18.258	18.301	18.343	18.385	18.428	18.470	18.513	440
450	18.513	18.555	18.598	18.640	18.683	18.725	18.768	18.810	18.853	18.895	18.938	450
460	18.938	18.980	19.023	19.065	19.108	19.150	19.193	19.235	19.278	19.320	19.363	460
470	19.363	19.405	19.448	19.490	19.533	19.576	19.618	19.661	19.703	19.746	19.788	470
480	19.788	19.831	19.873	19.916	19.959	20.001	20.044	20.086	20.129	20.172	20.214	480
490	20.214	20.257	20.299	20.342	20.385	20.427	20.470	20.512	20.555	20.598	20.640	490
500	20.640	20.683	20.725	20.768	20.811	20.853	20.896	20.938	20.981	21.024	21.066	500
510	21.066	21.109	21.152	21.194	21.237	21.280	21.322	21.365	21.407	21.450	21.493	510
520	21.493	21.535	21.578	21.621	21.663	21.706	21.749	21.791	21.834	21.876	21.919	520
530	21.919	21.962	22.004	22.047	22.090	22.132	22.175	22.218	22.260	22.303	22.346	530
540	22.346	22.388	22.431	22.473	22.516	22.559	22.601	22.644	22.687	22.729	22.772	540
550	22.772	22.815	22.857	22.900	22.942	22.985	23.028	23.070	23.113	23.156	23.198	550
560	23.198	23.241	23.284	23.326	23.369	23.411	23.454	23.497	23.539	23.582	23.624	560
570	23.624	23.667	23.710	23.752	23.795	23.837	23.880	23.923	23.965	24.008	24.050	570
580	24.050	24.093	24.136	24.178	24.221	24.263	24.306	24.348	24.391	24.434	24.476	580
590	24.476	24.519	24.561	24.604	24.646	24.689	24.731	24.774	24.817	24.859	24.902	590
600	24.902	24.944	24.987	25.029	25.072	25.114	25.157	25.199	25.242	25.284	25.327	600
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A7.1.1. Type K thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C—Continued

°C	0	1	2	3	4	5	6	7	8	9	10	°C
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	24.902	24.944	24.987	25.029	25.072	25.114	25.157	25.199	25.242	25.284	25.327	600
610	25.327	25.369	25.412	25.454	25.497	25.539	25.582	25.624	25.666	25.709	25.751	610
620	25.751	25.794	25.836	25.879	25.921	25.964	26.006	26.048	26.091	26.133	26.176	620
630	26.176	26.218	26.260	26.303	26.345	26.387	26.430	26.472	26.515	26.557	26.599	630
640	26.599	26.642	26.684	26.726	26.769	26.811	26.853	26.896	26.938	26.980	27.022	640
650	27.022	27.065	27.107	27.149	27.192	27.234	27.276	27.318	27.361	27.403	27.445	650
660	27.445	27.487	27.529	27.572	27.614	27.656	27.698	27.740	27.783	27.825	27.867	660
670	27.867	27.909	27.951	27.993	28.035	28.078	28.120	28.162	28.204	28.246	28.288	670
680	28.288	28.330	28.372	28.414	28.456	28.498	28.540	28.583	28.625	28.667	28.709	680
690	28.709	28.751	28.793	28.835	28.877	28.919	28.961	29.002	29.044	29.086	29.128	690
700	29.128	29.170	29.212	29.254	29.296	29.338	29.380	29.422	29.464	29.505	29.547	700
710	29.547	29.589	29.631	29.673	29.715	29.756	29.798	29.840	29.882	29.924	29.965	710
720	29.965	30.007	30.049	30.091	30.132	30.174	30.216	30.257	30.299	30.341	30.383	720
730	30.383	30.424	30.466	30.508	30.549	30.591	30.632	30.674	30.716	30.757	30.799	730
740	30.799	30.840	30.882	30.924	30.965	31.007	31.048	31.090	31.131	31.173	31.214	740
750	31.214	31.256	31.297	31.339	31.380	31.422	31.463	31.504	31.546	31.587	31.629	750
760	31.629	31.670	31.712	31.753	31.794	31.836	31.877	31.918	31.960	32.001	32.042	760
770	32.042	32.084	32.125	32.166	32.207	32.249	32.290	32.331	32.372	32.414	32.455	770
780	32.455	32.496	32.537	32.578	32.619	32.661	32.702	32.743	32.784	32.825	32.866	780
790	32.866	32.907	32.948	32.990	33.031	33.072	33.113	33.154	33.195	33.236	33.277	790
800	33.277	33.318	33.359	33.400	33.441	33.482	33.523	33.564	33.604	33.645	33.686	800
810	33.686	33.727	33.768	33.809	33.850	33.891	33.931	33.972	34.013	34.054	34.095	810
820	34.095	34.136	34.176	34.217	34.258	34.299	34.339	34.380	34.421	34.461	34.502	820
830	34.502	34.543	34.583	34.624	34.665	34.705	34.746	34.787	34.827	34.868	34.909	830
840	34.909	34.949	34.990	35.030	35.071	35.111	35.152	35.192	35.233	35.273	35.314	840
850	35.314	35.354	35.395	35.435	35.476	35.516	35.557	35.597	35.637	35.678	35.718	850
860	35.718	35.758	35.799	35.839	35.880	35.920	35.960	36.000	36.041	36.081	36.121	860
870	36.121	36.162	36.202	36.242	36.282	36.323	36.363	36.403	36.443	36.483	36.524	870
880	36.524	36.564	36.604	36.644	36.684	36.724	36.764	36.804	36.844	36.885	36.925	880
890	36.925	36.965	37.005	37.045	37.085	37.125	37.165	37.205	37.245	37.285	37.325	890
900	37.325	37.365	37.405	37.445	37.484	37.524	37.564	37.604	37.644	37.684	37.724	900
910	37.724	37.764	37.803	37.843	37.883	37.923	37.963	38.002	38.042	38.082	38.122	910
920	38.122	38.162	38.201	38.241	38.281	38.320	38.360	38.400	38.439	38.479	38.519	920
930	38.519	38.558	38.598	38.638	38.677	38.717	38.756	38.796	38.836	38.875	38.915	930
940	38.915	38.954	38.994	39.033	39.073	39.112	39.152	39.191	39.231	39.270	39.310	940
950	39.310	39.349	39.388	39.428	39.467	39.507	39.546	39.585	39.625	39.664	39.703	950
960	39.703	39.743	39.782	39.821	39.861	39.900	39.939	39.979	40.018	40.057	40.096	960
970	40.096	40.136	40.175	40.214	40.253	40.292	40.332	40.371	40.410	40.449	40.488	970
980	40.488	40.527	40.566	40.605	40.645	40.684	40.723	40.762	40.801	40.840	40.879	980
990	40.879	40.918	40.957	40.996	41.035	41.074	41.113	41.152	41.191	41.230	41.269	990
1,000	41.269	41.308	41.347	41.385	41.424	41.463	41.502	41.541	41.580	41.619	41.657	1,000
1,010	41.657	41.696	41.735	41.774	41.813	41.851	41.890	41.929	41.968	42.006	42.045	1,010
1,020	42.045	42.084	42.123	42.161	42.200	42.239	42.277	42.316	42.355	42.393	42.432	1,020
1,030	42.432	42.470	42.509	42.548	42.586	42.625	42.663	42.702	42.740	42.779	42.817	1,030
1,040	42.817	42.856	42.894	42.933	42.971	43.010	43.048	43.087	43.125	43.164	43.202	1,040
1,050	43.202	43.240	43.279	43.317	43.356	43.394	43.432	43.471	43.509	43.547	43.585	1,050
1,060	43.585	43.624	43.662	43.700	43.739	43.777	43.815	43.853	43.891	43.930	43.968	1,060
1,070	43.968	44.006	44.044	44.082	44.121	44.159	44.197	44.235	44.273	44.311	44.349	1,070
1,080	44.349	44.387	44.425	44.463	44.501	44.539	44.577	44.615	44.653	44.691	44.729	1,080
1,090	44.729	44.767	44.805	44.843	44.881	44.919	44.957	44.995	45.033	45.070	45.108	1,090
1,100	45.108	45.146	45.184	45.222	45.260	45.297	45.335	45.373	45.411	45.448	45.486	1,100
1,110	45.486	45.524	45.561	45.599	45.637	45.675	45.712	45.750	45.787	45.825	45.863	1,110
1,120	45.863	45.900	45.938	45.975	46.013	46.051	46.088	46.126	46.163	46.201	46.238	1,120
1,130	46.238	46.275	46.313	46.350	46.388	46.425	46.463	46.500	46.537	46.575	46.612	1,130
1,140	46.612	46.649	46.687	46.724	46.761	46.799	46.836	46.873	46.910	46.948	46.985	1,140
1,150	46.985	47.022	47.059	47.096	47.134	47.171	47.208	47.245	47.282	47.319	47.356	1,150
1,160	47.356	47.393	47.430	47.468	47.505	47.542	47.579	47.616	47.653	47.689	47.726	1,160
1,170	47.726	47.763	47.800	47.837	47.874	47.911	47.948	47.985	48.021	48.058	48.095	1,170
1,180	48.095	48.132	48.169	48.205	48.242	48.279	48.316	48.352	48.389	48.426	48.462	1,180
1,190	48.462	48.499	48.536	48.572	48.609	48.645	48.682	48.718	48.755	48.792	48.828	1,190
1,200	48.828	48.865	48.901	48.937	48.974	49.010	49.047	49.083	49.120	49.156	49.192	1,200
°C	0	1	2	3	4	5	6	7	8	9	10	°C

TABLE A7.1.1. *Type K thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C —Continued*

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,200	48.828	48.865	48.901	48.937	48.974	49.010	49.047	49.083	49.120	49.156	49.192	1,200
1,210	49.192	49.229	49.265	49.301	49.338	49.374	49.410	49.446	49.483	49.519	49.555	1,210
1,220	49.555	49.591	49.627	49.663	49.700	49.736	49.772	49.808	49.844	49.880	49.916	1,220
1,230	49.916	49.952	49.988	50.024	50.060	50.096	50.132	50.168	50.204	50.240	50.276	1,230
1,240	50.276	50.311	50.347	5.383	50.419	50.455	50.491	50.526	50.562	50.598	50.633	1,240
1,250	50.633	50.669	50.705	50.741	50.776	50.812	50.847	50.883	50.919	50.954	50.990	1,250
1,260	50.990	51.025	51.061	51.096	51.132	51.167	51.203	51.238	51.274	51.309	51.344	1,260
1,270	51.344	51.380	51.415	51.450	51.486	51.521	51.556	51.592	51.627	51.662	51.697	1,270
1,280	51.697	51.733	51.768	51.803	51.838	51.873	51.908	51.943	51.979	52.014	52.049	1,280
1,290	52.049	52.084	52.119	52.154	52.189	52.224	52.259	52.294	52.329	52.364	52.398	1,290
1,300	52.398	52.433	52.468	52.503	52.538	52.573	52.608	52.642	52.677	52.712	52.747	1,300
1,310	52.747	52.781	52.816	52.851	52.886	52.920	52.955	52.989	53.024	53.059	53.093	1,310
1,320	53.093	53.128	53.162	53.197	53.232	53.266	53.301	53.335	53.370	53.404	53.439	1,320
1,330	53.439	53.473	53.507	53.542	53.576	53.611	53.645	53.679	53.714	53.748	53.782	1,330
1,340	53.782	53.817	53.851	53.885	53.920	53.954	53.988	54.022	54.057	54.091	54.125	1,340
1,350	54.125	54.159	54.193	54.228	54.262	54.296	54.330	54.364	54.398	54.432	54.466	1,350
1,360	54.466	54.501	54.535	54.569	54.603	54.637	54.671	54.705	54.739	54.773	54.807	1,360
1,370	54.807	54.841	54.875									1,370
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A7.1.2. Type K thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-450	-6.456	-6.456	-6.457	-6.457	-6.458							-450
-440	-6.447	-6.448	-6.449	-6.450	-6.451	-6.452	-6.453	-6.454	-6.454	-6.455	-6.456	-440
-430	-6.431	-6.433	-6.435	-6.436	-6.438	-6.440	-6.441	-6.443	-6.444	-6.445	-6.447	-430
-420	-6.409	-6.411	-6.414	-6.416	-6.419	-6.421	-6.423	-6.425	-6.427	-6.429	-6.431	-420
-410	-6.380	-6.383	-6.386	-6.389	-6.392	-6.395	-6.398	-6.401	-6.404	-6.406	-6.409	-410
-400	-6.344	-6.348	-6.352	-6.355	-6.359	-6.363	-6.366	-6.370	-6.373	-6.377	-6.380	-400
-390	-6.301	-6.306	-6.310	-6.315	-6.319	-6.323	-6.328	-6.332	-6.336	-6.340	-6.344	-390
-380	-6.251	-6.257	-6.262	-6.267	-6.272	-6.277	-6.282	-6.287	-6.292	-6.296	-6.301	-380
-370	-6.195	-6.201	-6.207	-6.213	-6.219	-6.224	-6.230	-6.235	-6.241	-6.246	-6.251	-370
-360	-6.133	-6.139	-6.146	-6.152	-6.158	-6.165	-6.171	-6.177	-6.183	-6.189	-6.195	-360
-350	-6.064	-6.071	-6.078	-6.085	-6.092	-6.099	-6.106	-6.113	-6.119	-6.126	-6.133	-350
-340	-5.989	-5.997	-6.004	-6.012	-6.020	-6.027	-6.035	-6.042	-6.049	-6.057	-6.064	-340
-330	-5.908	-5.917	-5.925	-5.933	-5.941	-5.949	-5.957	-5.965	-5.973	-5.981	-5.989	-330
-320	-5.822	-5.831	-5.839	-5.848	-5.857	-5.866	-5.874	-5.883	-5.891	-5.900	-5.908	-320
-310	-5.730	-5.739	-5.748	-5.758	-5.767	-5.776	-5.786	-5.795	-5.804	-5.813	-5.822	-310
-300	-5.632	-5.642	-5.652	-5.662	-5.672	-5.682	-5.691	-5.701	-5.711	-5.720	-5.730	-300
-290	-5.529	-5.540	-5.550	-5.561	-5.571	-5.581	-5.592	-5.602	-5.612	-5.622	-5.632	-290
-280	-5.421	-5.432	-5.443	-5.454	-5.465	-5.476	-5.487	-5.497	-5.508	-5.519	-5.529	-280
-270	-5.308	-5.319	-5.331	-5.342	-5.354	-5.365	-5.376	-5.388	-5.399	-5.410	-5.421	-270
-260	-5.190	-5.202	-5.214	-5.226	-5.238	-5.249	-5.261	-5.273	-5.285	-5.296	-5.308	-260
-250	-5.067	-5.079	-5.092	-5.104	-5.116	-5.129	-5.141	-5.153	-5.165	-5.178	-5.190	-250
-240	-4.939	-4.952	-4.965	-4.978	-4.990	-5.003	-5.016	-5.029	-5.041	-5.054	-5.067	-240
-230	-4.806	-4.819	-4.833	-4.846	-4.860	-4.873	-4.886	-4.899	-4.912	-4.926	-4.939	-230
-220	-4.669	-4.683	-4.697	-4.710	-4.724	-4.738	-4.752	-4.765	-4.779	-4.792	-4.806	-220
-210	-4.527	-4.541	-4.556	-4.570	-4.584	-4.598	-4.613	-4.627	-4.641	-4.655	-4.669	-210
-200	-4.381	-4.396	-4.410	-4.425	-4.440	-4.454	-4.469	-4.484	-4.498	-4.512	-4.527	-200
-190	-4.230	-4.245	-4.261	-4.276	-4.291	-4.306	-4.321	-4.336	-4.351	-4.366	-4.381	-190
-180	-4.075	-4.091	-4.107	-4.122	-4.138	-4.153	-4.169	-4.184	-4.200	-4.215	-4.230	-180
-170	-3.917	-3.933	-3.949	-3.965	-3.981	-3.997	-4.012	-4.028	-4.044	-4.060	-4.075	-170
-160	-3.754	-3.770	-3.787	-3.803	-3.819	-3.836	-3.852	-3.868	-3.884	-3.901	-3.917	-160
-150	-3.587	-3.604	-3.621	-3.637	-3.654	-3.671	-3.688	-3.704	-3.721	-3.737	-3.754	-150
-140	-3.417	-3.434	-3.451	-3.468	-3.485	-3.502	-3.519	-3.536	-3.553	-3.570	-3.587	-140
-130	-3.242	-3.260	-3.277	-3.295	-3.312	-3.330	-3.347	-3.365	-3.382	-3.399	-3.417	-130
-120	-3.065	-3.082	-3.100	-3.118	-3.136	-3.154	-3.172	-3.189	-3.207	-3.225	-3.242	-120
-110	-2.883	-2.902	-2.920	-2.938	-2.956	-2.974	-2.992	-3.010	-3.029	-3.047	-3.065	-110
-100	-2.699	-2.717	-2.736	-2.754	-2.773	-2.791	-2.810	-2.828	-2.847	-2.865	-2.883	-100
-90	-2.511	-2.530	-2.549	-2.567	-2.586	-2.605	-2.624	-2.643	-2.661	-2.680	-2.699	-90
-80	-2.320	-2.339	-2.358	-2.377	-2.397	-2.416	-2.435	-2.454	-2.473	-2.492	-2.511	-80
-70	-2.126	-2.145	-2.165	-2.184	-2.204	-2.223	-2.243	-2.262	-2.281	-2.300	-2.320	-70
-60	-1.929	-1.949	-1.968	-1.988	-2.008	-2.028	-2.047	-2.067	-2.087	-2.106	-2.126	-60
-50	-1.729	-1.749	-1.769	-1.789	-1.809	-1.829	-1.849	-1.869	-1.889	-1.909	-1.929	-50
-40	-1.527	-1.547	-1.567	-1.588	-1.608	-1.628	-1.648	-1.669	-1.689	-1.709	-1.729	-40
-30	-1.322	-1.342	-1.363	-1.383	-1.404	-1.424	-1.445	-1.465	-1.486	-1.506	-1.527	-30
-20	-1.114	-1.135	-1.156	-1.177	-1.197	-1.218	-1.239	-1.260	-1.280	-1.301	-1.322	-20
-10	-0.904	-0.925	-0.946	-0.968	-0.989	-1.010	-1.031	-1.051	-1.072	-1.093	-1.114	-10
- 0	-0.692	-0.714	-0.735	-0.756	-0.777	-0.799	-0.820	-0.841	-0.862	-0.883	-0.904	- 0
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A7.1.2. Type K thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	-0.692	-0.671	-0.650	-0.628	-0.607	-0.585	-0.564	-0.543	-0.521	-0.500	-0.478	0
10	-0.478	-0.457	-0.435	-0.413	-0.392	-0.370	-0.349	-0.327	-0.305	-0.284	-0.262	10
20	-0.262	-0.240	-0.218	-0.197	-0.175	-0.153	-0.131	-0.109	-0.088	-0.066	-0.044	20
30	-0.044	-0.022	0.000	0.022	0.044	0.066	0.088	0.110	0.132	0.154	0.176	30
40	0.176	0.198	0.220	0.242	0.264	0.286	0.308	0.331	0.353	0.375	0.397	40
50	0.397	0.419	0.441	0.464	0.486	0.508	0.530	0.553	0.575	0.597	0.619	50
60	0.619	0.642	0.664	0.686	0.709	0.731	0.753	0.776	0.798	0.821	0.843	60
70	0.843	0.865	0.888	0.910	0.933	0.955	0.978	1.000	1.023	1.045	1.068	70
80	1.068	1.090	1.113	1.135	1.158	1.181	1.203	1.226	1.248	1.271	1.294	80
90	1.294	1.316	1.339	1.362	1.384	1.407	1.430	1.452	1.475	1.498	1.520	90
100	1.520	1.543	1.566	1.589	1.611	1.634	1.657	1.680	1.703	1.725	1.748	100
110	1.748	1.771	1.794	1.817	1.839	1.862	1.885	1.908	1.931	1.954	1.977	110
120	1.977	2.000	2.022	2.045	2.068	2.091	2.114	2.137	2.160	2.183	2.206	120
130	2.206	2.229	2.252	2.275	2.298	2.321	2.344	2.367	2.390	2.413	2.436	130
140	2.436	2.459	2.482	2.505	2.528	2.551	2.574	2.597	2.620	2.643	2.666	140
150	2.666	2.689	2.712	2.735	2.758	2.781	2.804	2.827	2.850	2.873	2.896	150
160	2.896	2.920	2.943	2.966	2.989	3.012	3.035	3.058	3.081	3.104	3.127	160
170	3.127	3.150	3.173	3.196	3.220	3.243	3.266	3.289	3.312	3.335	3.358	170
180	3.358	3.381	3.404	3.427	3.450	3.473	3.496	3.519	3.543	3.566	3.589	180
190	3.589	3.612	3.635	3.658	3.681	3.704	3.727	3.750	3.773	3.796	3.819	190
200	3.819	3.842	3.865	3.888	3.911	3.934	3.957	3.980	4.003	4.026	4.049	200
210	4.049	4.072	4.095	4.118	4.141	4.164	4.187	4.210	4.233	4.256	4.279	210
220	4.279	4.302	4.325	4.348	4.371	4.394	4.417	4.439	4.462	4.485	4.508	220
230	4.508	4.531	4.554	4.577	4.600	4.622	4.645	4.668	4.691	4.714	4.737	230
240	4.737	4.759	4.782	4.805	4.828	4.851	4.873	4.896	4.919	4.942	4.964	240
250	4.964	4.987	5.010	5.033	5.055	5.078	5.101	5.124	5.146	5.169	5.192	250
260	5.192	5.214	5.237	5.260	5.282	5.305	5.327	5.350	5.373	5.395	5.418	260
270	5.418	5.440	5.463	5.486	5.508	5.531	5.553	5.576	5.598	5.621	5.643	270
280	5.643	5.666	5.688	5.711	5.733	5.756	5.778	5.801	5.823	5.846	5.868	280
290	5.868	5.891	5.913	5.936	5.958	5.980	6.003	6.025	6.048	6.070	6.092	290
300	6.092	6.115	6.137	6.160	6.182	6.204	6.227	6.249	6.271	6.294	6.316	300
310	6.316	6.338	6.361	6.383	6.405	6.428	6.450	6.472	6.494	6.517	6.539	310
320	6.539	6.561	6.583	6.606	6.628	6.650	6.672	6.695	6.717	6.739	6.761	320
330	6.761	6.784	6.806	6.828	6.850	6.873	6.895	6.917	6.939	6.961	6.984	330
340	6.984	7.006	7.028	7.050	7.072	7.094	7.117	7.139	7.161	7.183	7.205	340
350	7.205	7.228	7.250	7.272	7.294	7.316	7.338	7.361	7.383	7.405	7.427	350
360	7.427	7.449	7.471	7.494	7.516	7.538	7.560	7.582	7.604	7.627	7.649	360
370	7.649	7.671	7.693	7.715	7.737	7.760	7.782	7.804	7.826	7.848	7.870	370
380	7.870	7.893	7.915	7.937	7.959	7.981	8.003	8.026	8.048	8.070	8.092	380
390	8.092	8.114	8.137	8.159	8.181	8.203	8.225	8.248	8.270	8.292	8.314	390
400	8.314	8.336	8.359	8.381	8.403	8.425	8.448	8.470	8.492	8.514	8.537	400
410	8.537	8.559	8.581	8.603	8.626	8.648	8.670	8.692	8.715	8.737	8.759	410
420	8.759	8.782	8.804	8.826	8.849	8.871	8.893	8.916	8.938	8.960	8.983	420
430	8.983	9.005	9.027	9.050	9.072	9.094	9.117	9.139	9.161	9.184	9.206	430
440	9.206	9.229	9.251	9.273	9.296	9.318	9.341	9.363	9.385	9.408	9.430	440
450	9.430	9.453	9.475	9.498	9.520	9.543	9.565	9.588	9.610	9.633	9.655	450
460	9.655	9.678	9.700	9.723	9.745	9.768	9.790	9.813	9.835	9.858	9.880	460
470	9.880	9.903	9.926	9.948	9.971	9.993	10.016	10.038	10.061	10.084	10.106	470
480	10.106	10.129	10.151	10.174	10.197	10.219	10.242	10.265	10.287	10.310	10.333	480
490	10.333	10.355	10.378	10.401	10.423	10.446	10.469	10.491	10.514	10.537	10.560	490
500	10.560	10.582	10.605	10.628	10.650	10.673	10.696	10.719	10.741	10.764	10.787	500
510	10.787	10.810	10.833	10.855	10.878	10.901	10.924	10.947	10.969	10.992	11.015	510
520	11.015	11.038	11.061	11.083	11.106	11.129	11.152	11.175	11.198	11.221	11.243	520
530	11.243	11.266	11.289	11.312	11.335	11.358	11.381	11.404	11.426	11.449	11.472	530
540	11.472	11.495	11.518	11.541	11.564	11.587	11.610	11.633	11.656	11.679	11.702	540
550	11.702	11.725	11.748	11.770	11.793	11.816	11.839	11.862	11.885	11.908	11.931	550
560	11.931	11.954	11.977	12.000	12.023	12.046	12.069	12.092	12.115	12.138	12.161	560
570	12.161	12.184	12.207	12.230	12.254	12.277	12.300	12.323	12.346	12.369	12.392	570
580	12.392	12.415	12.438	12.461	12.484	12.507	12.530	12.553	12.576	12.599	12.623	580
590	12.623	12.646	12.669	12.692	12.715	12.738	12.761	12.784	12.807	12.831	12.854	590
600	12.854	12.877	12.900	12.923	12.946	12.969	12.992	13.016	13.039	13.062	13.085	600
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A7.1.2. Type K thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F —Continued

$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	12.854	12.877	12.900	12.923	12.946	12.969	12.992	13.016	13.039	13.062	13.085	600
610	13.085	13.108	13.131	13.154	13.178	13.201	13.224	13.247	13.270	13.293	13.317	610
620	13.317	13.340	13.363	13.386	13.409	13.433	13.456	13.479	13.502	13.525	13.549	620
630	13.549	13.572	13.595	13.618	13.641	13.665	13.688	13.711	13.734	13.757	13.781	630
640	13.781	13.804	13.827	13.850	13.874	13.897	13.920	13.943	13.967	13.990	14.013	640
650	14.013	14.036	14.060	14.083	14.106	14.129	14.153	14.176	14.199	14.222	14.246	650
660	14.246	14.269	14.292	14.316	14.339	14.362	14.385	14.409	14.432	14.455	14.479	660
670	14.479	14.502	14.525	14.548	14.572	14.595	14.618	14.642	14.665	14.688	14.712	670
680	14.712	14.735	14.758	14.782	14.805	14.828	14.852	14.875	14.898	14.922	14.945	680
690	14.945	14.968	14.992	15.015	15.038	15.062	15.085	15.108	15.132	15.155	15.178	690
700	15.178	15.202	15.225	15.248	15.272	15.295	15.318	15.342	15.365	15.389	15.412	700
710	15.412	15.435	15.459	15.482	15.505	15.529	15.552	15.576	15.599	15.622	15.646	710
720	15.646	15.669	15.693	15.716	15.739	15.763	15.786	15.810	15.833	15.856	15.880	720
730	15.880	15.903	15.927	15.950	15.974	15.997	16.020	16.044	16.067	16.091	16.114	730
740	16.114	16.138	16.161	16.184	16.208	16.231	16.255	16.278	16.302	16.325	16.349	740
750	16.349	16.372	16.395	16.419	16.442	16.466	16.489	16.513	16.536	16.560	16.583	750
760	16.583	16.607	16.630	16.654	16.677	16.700	16.724	16.747	16.771	16.794	16.818	760
770	16.818	16.841	16.865	16.888	16.912	16.935	16.959	16.982	17.006	17.029	17.053	770
780	17.053	17.076	17.100	17.123	17.147	17.170	17.194	17.217	17.241	17.264	17.288	780
790	17.288	17.311	17.335	17.358	17.382	17.406	17.429	17.453	17.476	17.500	17.523	790
800	17.523	17.547	17.570	17.594	17.617	17.641	17.664	17.688	17.711	17.735	17.759	800
810	17.759	17.782	17.806	17.829	17.853	17.876	17.900	17.923	17.947	17.971	17.994	810
820	17.994	18.018	18.041	18.065	18.088	18.112	18.136	18.159	18.183	18.206	18.230	820
830	18.230	18.253	18.277	18.301	18.324	18.348	18.371	18.395	18.418	18.442	18.466	830
840	18.466	18.489	18.513	18.536	18.560	18.584	18.607	18.631	18.654	18.678	18.702	840
850	18.702	18.725	18.749	18.772	18.796	18.820	18.843	18.867	18.890	18.914	18.938	850
860	18.938	18.961	18.985	19.008	19.032	19.056	19.079	19.103	19.127	19.150	19.174	860
870	19.174	19.197	19.221	19.245	19.268	19.292	19.316	19.339	19.363	19.386	19.410	870
880	19.410	19.434	19.457	19.481	19.505	19.528	19.552	19.576	19.599	19.623	19.646	880
890	19.646	19.670	19.694	19.717	19.741	19.765	19.788	19.812	19.836	19.859	19.883	890
900	19.883	19.907	19.930	19.954	19.978	20.001	20.025	20.049	20.072	20.096	20.120	900
910	20.120	20.143	20.167	20.190	20.214	20.238	20.261	20.285	20.309	20.332	20.356	910
920	20.356	20.380	20.403	20.427	20.451	20.474	20.498	20.522	20.545	20.569	20.593	920
930	20.593	20.616	20.640	20.664	20.688	20.711	20.735	20.759	20.782	20.806	20.830	930
940	20.830	20.853	20.877	20.901	20.924	20.948	20.972	20.995	21.019	21.043	21.066	940
950	21.066	21.090	21.114	21.137	21.161	21.185	21.208	21.232	21.256	21.280	21.303	950
960	21.303	21.327	21.351	21.374	21.398	21.422	21.445	21.469	21.493	21.516	21.540	960
970	21.540	21.564	21.587	21.611	21.635	21.659	21.682	21.706	21.730	21.753	21.777	970
980	21.777	21.801	21.824	21.848	21.872	21.895	21.919	21.943	21.966	21.990	22.014	980
990	22.014	22.038	22.061	22.085	22.109	22.132	22.156	22.180	22.203	22.227	22.251	990
1,000	22.251	22.274	22.298	22.322	22.346	22.369	22.393	22.417	22.440	22.464	22.488	1,000
1,010	22.488	22.511	22.535	22.559	22.582	22.606	22.630	22.654	22.677	22.701	22.725	1,010
1,020	22.725	22.748	22.772	22.796	22.819	22.843	22.867	22.890	22.914	22.938	22.961	1,020
1,030	22.961	22.985	23.009	23.032	23.056	23.080	23.104	23.127	23.151	23.175	23.198	1,030
1,040	23.198	23.222	23.246	23.269	23.293	23.317	23.340	23.364	23.388	23.411	23.435	1,040
1,050	23.435	23.459	23.482	23.506	23.530	23.553	23.577	23.601	23.624	23.648	23.672	1,050
1,060	23.672	23.695	23.719	23.743	23.766	23.790	23.814	23.837	23.861	23.885	23.908	1,060
1,070	23.908	23.932	23.956	23.979	24.003	24.027	24.050	24.074	24.098	24.121	24.145	1,070
1,080	24.145	24.169	24.192	24.216	24.240	24.263	24.287	24.311	24.334	24.358	24.382	1,080
1,090	24.382	24.405	24.429	24.453	24.476	24.500	24.523	24.547	24.571	24.594	24.618	1,090
1,100	24.618	24.642	24.665	24.689	24.713	24.736	24.760	24.783	24.807	24.831	24.854	1,100
1,110	24.854	24.878	24.902	24.925	24.949	24.972	24.996	25.020	25.043	25.067	25.091	1,110
1,120	25.091	25.114	25.138	25.161	25.185	25.209	25.232	25.256	25.279	25.303	25.327	1,120
1,130	25.327	25.350	25.374	25.397	25.421	25.445	25.468	25.492	25.515	25.539	25.563	1,130
1,140	25.563	25.586	25.610	25.633	25.657	25.681	25.704	25.728	25.751	25.775	25.799	1,140
1,150	25.799	25.822	25.846	25.869	25.893	25.916	25.940	25.964	25.987	26.011	26.034	1,150
1,160	26.034	26.058	26.081	26.105	26.128	26.152	26.176	26.199	26.223	26.246	26.270	1,160
1,170	26.270	26.293	26.317	26.340	26.364	26.387	26.411	26.435	26.458	26.482	26.505	1,170
1,180	26.505	26.529	26.552	26.576	26.599	26.623	26.646	26.670	26.693	26.717	26.740	1,180
1,190	26.740	26.764	26.787	26.811	26.834	26.858	26.881	26.905	26.928	26.952	26.975	1,190
1,200	26.975	26.999	27.022	27.046	27.069	27.093	27.116	27.140	27.163	27.187	27.210	1,200
$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$

TABLE A7.1.2. Type K thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,200	26.975	26.999	27.022	27.046	27.069	27.093	27.116	27.140	27.163	27.187	27.210	1,200
1,210	27.210	27.234	27.257	27.281	27.304	27.328	27.351	27.375	27.398	27.422	27.445	1,210
1,220	27.445	27.468	27.492	27.515	27.539	27.562	27.586	27.609	27.633	27.656	27.679	1,220
1,230	27.679	27.703	27.726	27.750	27.773	27.797	27.820	27.843	27.867	27.890	27.914	1,230
1,240	27.914	27.937	27.961	27.984	28.007	28.031	28.054	28.078	28.101	28.124	28.148	1,240
1,250	28.148	28.171	28.195	28.218	28.241	28.265	28.288	28.311	28.335	28.358	28.382	1,250
1,260	28.382	28.405	28.428	28.452	28.475	28.498	28.522	28.545	28.569	28.592	28.615	1,260
1,270	28.615	28.639	28.662	28.685	28.709	28.732	28.755	28.779	28.802	28.825	28.849	1,270
1,280	28.849	28.872	28.895	28.919	28.942	28.965	28.988	29.012	29.035	29.058	29.082	1,280
1,290	29.082	29.105	29.128	29.152	29.175	29.198	29.221	29.245	29.268	29.291	29.315	1,290
1,300	29.315	29.338	29.361	29.384	29.408	29.431	29.454	29.477	29.501	29.524	29.547	1,300
1,310	29.547	29.570	29.594	29.617	29.640	29.663	29.687	29.710	29.733	29.756	29.780	1,310
1,320	29.780	29.803	29.826	29.849	29.872	29.896	29.919	29.942	29.965	29.989	30.012	1,320
1,330	30.012	30.035	30.058	30.081	30.104	30.128	30.151	30.174	30.197	30.220	30.244	1,330
1,340	30.244	30.267	30.290	30.313	30.336	30.359	30.383	30.406	30.429	30.452	30.475	1,340
1,350	30.475	30.498	30.521	30.545	30.568	30.591	30.614	30.637	30.660	30.683	30.706	1,350
1,360	30.706	30.730	30.753	30.776	30.799	30.822	30.845	30.868	30.891	30.914	30.937	1,360
1,370	30.937	30.961	30.984	31.007	31.030	31.053	31.076	31.099	31.122	31.145	31.168	1,370
1,380	31.168	31.191	31.214	31.237	31.260	31.283	31.306	31.329	31.353	31.376	31.399	1,380
1,390	31.399	31.422	31.445	31.468	31.491	31.514	31.537	31.560	31.583	31.606	31.629	1,390
1,400	31.629	31.652	31.675	31.698	31.721	31.744	31.767	31.790	31.813	31.836	31.859	1,400
1,410	31.859	31.882	31.905	31.927	31.950	31.973	31.996	32.019	32.042	32.065	32.088	1,410
1,420	32.088	32.111	32.134	32.157	32.180	32.203	32.226	32.249	32.272	32.294	32.317	1,420
1,430	32.317	32.340	32.363	32.386	32.409	32.432	32.455	32.478	32.501	32.523	32.546	1,430
1,440	32.546	32.569	32.592	32.615	32.638	32.661	32.683	32.706	32.729	32.752	32.775	1,440
1,450	32.775	32.798	32.821	32.843	32.866	32.889	32.912	32.935	32.958	32.980	33.003	1,450
1,460	33.003	33.026	33.049	33.072	33.094	33.117	33.140	33.163	33.186	33.208	33.231	1,460
1,470	33.231	33.254	33.277	33.300	33.322	33.345	33.368	33.391	33.413	33.436	33.459	1,470
1,480	33.459	33.482	33.504	33.527	33.550	33.573	33.595	33.618	33.641	33.664	33.686	1,480
1,490	33.686	33.709	33.732	33.754	33.777	33.800	33.823	33.845	33.868	33.891	33.913	1,490
1,500	33.913	33.936	33.959	33.981	34.004	34.027	34.049	34.072	34.095	34.117	34.140	1,500
1,510	34.140	34.163	34.185	34.208	34.231	34.253	34.276	34.299	34.321	34.344	34.366	1,510
1,520	34.366	34.389	34.412	34.434	34.457	34.480	34.502	34.525	34.547	34.570	34.593	1,520
1,530	34.593	34.615	34.638	34.660	34.683	34.705	34.728	34.751	34.773	34.796	34.818	1,530
1,540	34.818	34.841	34.863	34.886	34.909	34.931	34.954	34.976	34.999	35.021	35.044	1,540
1,550	35.044	35.066	35.089	35.111	35.134	35.156	35.179	35.201	35.224	35.246	35.269	1,550
1,560	35.269	35.291	35.314	35.336	35.359	35.381	35.404	35.426	35.449	35.471	35.494	1,560
1,570	35.494	35.516	35.539	35.561	35.583	35.606	35.628	35.651	35.673	35.696	35.718	1,570
1,580	35.718	35.741	35.763	35.785	35.808	35.830	35.853	35.875	35.897	35.920	35.942	1,580
1,590	35.942	35.965	35.987	36.009	36.032	36.054	36.077	36.099	36.121	36.144	36.166	1,590
1,600	36.166	36.188	36.211	36.233	36.256	36.278	36.300	36.323	36.345	36.367	36.390	1,600
1,610	36.390	36.412	36.434	36.457	36.479	36.501	36.524	36.546	36.568	36.590	36.613	1,610
1,620	36.613	36.635	36.657	36.680	36.702	36.724	36.746	36.769	36.791	36.813	36.836	1,620
1,630	36.836	36.858	36.880	36.902	36.925	36.947	36.969	36.991	37.014	37.036	37.058	1,630
1,640	37.058	37.080	37.103	37.125	37.147	37.169	37.191	37.214	37.236	37.258	37.280	1,640
1,650	37.280	37.303	37.325	37.347	37.369	37.391	37.413	37.436	37.458	37.480	37.502	1,650
1,660	37.502	37.524	37.547	37.569	37.591	37.613	37.635	37.657	37.679	37.702	37.724	1,660
1,670	37.724	37.746	37.768	37.790	37.812	37.834	37.857	37.879	37.901	37.923	37.945	1,670
1,680	37.945	37.967	37.989	38.011	38.033	38.055	38.078	38.100	38.122	38.144	38.166	1,680
1,690	38.166	38.188	38.210	38.232	38.254	38.276	38.298	38.320	38.342	38.364	38.387	1,690
1,700	38.387	38.409	38.431	38.453	38.475	38.497	38.519	38.541	38.563	38.585	38.607	1,700
1,710	38.607	38.629	38.651	38.673	38.695	38.717	38.739	38.761	38.783	38.805	38.827	1,710
1,720	38.827	38.849	38.871	38.893	38.915	38.937	38.959	38.981	39.003	39.024	39.046	1,720
1,730	39.046	39.068	39.090	39.112	39.134	39.156	39.178	39.200	39.222	39.244	39.266	1,730
1,740	39.266	39.288	39.310	39.331	39.353	39.375	39.397	39.419	39.441	39.463	39.485	1,740
1,750	39.485	39.507	39.529	39.550	39.572	39.594	39.616	39.638	39.660	39.682	39.703	1,750
1,760	39.703	39.725	39.747	39.769	39.791	39.813	39.835	39.856	39.878	39.900	39.922	1,760
1,770	39.922	39.944	39.965	39.987	40.009	40.031	40.053	40.075	40.096	40.118	40.140	1,770
1,780	40.140	40.162	40.183	40.205	40.227	40.249	40.271	40.292	40.314	40.336	40.358	1,780
1,790	40.358	40.379	40.401	40.423	40.445	40.466	40.488	40.510	40.532	40.553	40.575	1,790
1,800	40.575	40.597	40.619	40.640	40.662	40.684	40.705	40.727	40.749	40.770	40.792	1,800

TABLE A7.1.2. Type K thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
1,800	40.575	40.597	40.619	40.640	40.662	40.684	40.705	40.727	40.749	40.770	40.792	1,800
1,810	40.792	40.814	40.836	40.857	40.879	40.901	40.922	40.944	40.966	40.987	41.009	1,810
1,820	41.009	41.031	41.052	41.074	41.096	41.117	41.139	41.161	41.182	41.204	41.225	1,820
1,830	41.225	41.247	41.269	41.290	41.312	41.334	41.355	41.377	41.398	41.420	41.442	1,830
1,840	41.442	41.463	41.485	41.506	41.528	41.550	41.571	41.593	41.614	41.636	41.657	1,840
1,850	41.657	41.679	41.701	41.722	41.744	41.765	41.787	41.808	41.830	41.851	41.873	1,850
1,860	41.873	41.895	41.916	41.938	41.959	41.981	42.002	42.024	42.045	42.067	42.088	1,860
1,870	42.088	42.110	42.131	42.153	42.174	42.196	42.217	42.239	42.260	42.282	42.303	1,870
1,880	42.303	42.325	42.346	42.367	42.389	42.410	42.432	42.453	42.475	42.496	42.518	1,880
1,890	42.518	42.539	42.560	42.582	42.603	42.625	42.646	42.668	42.689	42.710	42.732	1,890
1,900	42.732	42.753	42.775	42.796	42.817	42.839	42.860	42.882	42.903	42.924	42.946	1,900
1,910	42.946	42.967	42.989	43.010	43.031	43.053	43.074	43.095	43.117	43.138	43.159	1,910
1,920	43.159	43.181	43.202	43.223	43.245	43.266	43.287	43.309	43.330	43.351	43.373	1,920
1,930	43.373	43.394	43.415	43.436	43.458	43.479	43.500	43.522	43.543	43.564	43.585	1,930
1,940	43.585	43.607	43.628	43.649	43.671	43.692	43.713	43.734	43.756	43.777	43.798	1,940
1,950	43.798	43.819	43.841	43.862	43.883	43.904	43.925	43.947	43.968	43.989	44.010	1,950
1,960	44.010	44.031	44.053	44.074	44.095	44.116	44.137	44.159	44.180	44.201	44.222	1,960
1,970	44.222	44.243	44.265	44.286	44.307	44.328	44.349	44.370	44.391	44.413	44.434	1,970
1,980	44.434	44.455	44.476	44.497	44.518	44.539	44.560	44.582	44.603	44.624	44.645	1,980
1,990	44.645	44.666	44.687	44.708	44.729	44.750	44.771	44.793	44.814	44.835	44.856	1,990
2,000	44.856	44.877	44.898	44.919	44.940	44.961	44.982	45.003	45.024	45.045	45.066	2,000
2,010	45.066	45.087	45.108	45.129	45.150	45.171	45.192	45.213	45.234	45.255	45.276	2,010
2,020	45.276	45.297	45.318	45.339	45.360	45.381	45.402	45.423	45.444	45.465	45.486	2,020
2,030	45.486	45.507	45.528	45.549	45.570	45.591	45.612	45.633	45.654	45.675	45.695	2,030
2,040	45.695	45.716	45.737	45.758	45.779	45.800	45.821	45.842	45.863	45.884	45.904	2,040
2,050	45.904	45.925	45.946	45.967	45.988	46.009	46.030	46.051	46.071	46.092	46.113	2,050
2,060	46.113	46.134	46.155	46.176	46.196	46.217	46.238	46.259	46.280	46.300	46.321	2,060
2,070	46.321	46.342	46.363	46.384	46.404	46.425	46.446	46.467	46.488	46.508	46.529	2,070
2,080	46.529	46.550	46.571	46.591	46.612	46.633	46.654	46.674	46.695	46.716	46.737	2,080
2,090	46.737	46.757	46.778	46.799	46.819	46.840	46.861	46.881	46.902	46.923	46.944	2,090
2,100	46.944	46.964	46.985	47.006	47.026	47.047	47.068	47.088	47.109	47.130	47.150	2,100
2,110	47.150	47.171	47.191	47.212	47.233	47.253	47.274	47.295	47.315	47.336	47.356	2,110
2,120	47.356	47.377	47.398	47.418	47.439	47.459	47.480	47.500	47.521	47.542	47.562	2,120
2,130	47.562	47.583	47.603	47.624	47.644	47.665	47.685	47.706	47.726	47.747	47.767	2,130
2,140	47.767	47.788	47.808	47.829	47.849	47.870	47.890	47.911	47.931	47.952	47.972	2,140
2,150	47.972	47.993	48.013	48.034	48.054	48.075	48.095	48.116	48.136	48.156	48.177	2,150
2,160	48.177	48.197	48.218	48.238	48.258	48.279	48.299	48.320	48.340	48.360	48.381	2,160
2,170	48.381	48.401	48.422	48.442	48.462	48.483	48.503	48.523	48.544	48.564	48.584	2,170
2,180	48.584	48.605	48.625	48.645	48.666	48.686	48.706	48.727	48.747	48.767	48.787	2,180
2,190	48.787	48.808	48.828	48.848	48.869	48.889	48.909	48.929	48.950	48.970	48.990	2,190
2,200	48.990	49.010	49.031	49.051	49.071	49.091	49.111	49.132	49.152	49.172	49.192	2,200
2,210	49.192	49.212	49.233	49.253	49.273	49.293	49.313	49.333	49.354	49.374	49.394	2,210
2,220	49.394	49.414	49.434	49.454	49.474	49.495	49.515	49.535	49.555	49.575	49.595	2,220
2,230	49.595	49.615	49.635	49.655	49.675	49.696	49.716	49.736	49.756	49.776	49.796	2,230
2,240	49.796	49.816	49.836	49.856	49.876	49.896	49.916	49.936	49.956	49.976	49.996	2,240
2,250	49.996	50.016	50.036	50.056	50.076	50.096	50.116	50.136	50.156	50.176	50.196	2,250
2,260	50.196	50.216	50.236	50.256	50.276	50.296	50.315	50.335	50.355	50.375	50.395	2,260
2,270	50.395	50.415	50.435	50.455	50.475	50.494	50.514	50.534	50.554	50.574	50.594	2,270
2,280	50.594	50.614	50.633	50.653	50.673	50.693	50.713	50.733	50.752	50.772	50.792	2,280
2,290	50.792	50.812	50.832	50.851	50.871	50.891	50.911	50.930	50.950	50.970	50.990	2,290
2,300	50.990	51.009	51.029	51.049	51.069	51.088	51.108	51.128	51.148	51.167	51.187	2,300
2,310	51.187	51.207	51.226	51.246	51.266	51.285	51.305	51.325	51.344	51.364	51.384	2,310
2,320	51.384	51.403	51.423	51.443	51.462	51.482	51.501	51.521	51.541	51.560	51.580	2,320
2,330	51.580	51.599	51.619	51.639	51.658	51.678	51.697	51.717	51.736	51.756	51.776	2,330
2,340	51.776	51.795	51.815	51.834	51.854	51.873	51.893	51.912	51.932	51.951	51.971	2,340
2,350	51.971	51.990	52.010	52.029	52.049	52.068	52.088	52.107	52.127	52.146	52.165	2,350
2,360	52.165	52.185	52.204	52.224	52.243	52.263	52.282	52.301	52.321	52.340	52.360	2,360
2,370	52.360	52.379	52.398	52.418	52.437	52.457	52.476	52.495	52.515	52.534	52.553	2,370
2,380	52.553	52.573	52.592	52.611	52.631	52.650	52.669	52.689	52.708	52.727	52.747	2,380
2,390	52.747	52.766	52.785	52.805	52.824	52.843	52.862	52.882	52.901	52.920	52.939	2,390
2,400	52.939	52.959	52.978	52.997	53.016	53.036	53.055	53.074	53.093	53.113	53.132	2,400
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A7.1.2. Type K thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
2,400	52.939	52.959	52.978	52.997	53.016	53.036	53.055	53.074	53.093	53.113	53.132	2,400
2,410	53.132	53.151	53.170	53.189	53.209	53.228	53.247	53.266	53.285	53.304	53.324	2,410
2,420	53.324	53.343	53.362	53.381	53.400	53.419	53.439	53.458	53.477	53.496	53.515	2,420
2,430	53.515	53.534	53.553	53.572	53.592	53.611	53.630	53.649	53.668	53.687	53.706	2,430
2,440	53.706	53.725	53.744	53.763	53.782	53.801	53.821	53.840	53.859	53.878	53.897	2,440
2,450	53.897	53.916	53.935	53.954	53.973	53.992	54.011	54.030	54.049	54.068	54.087	2,450
2,460	54.087	54.106	54.125	54.144	54.163	54.182	54.201	54.220	54.239	54.258	54.277	2,460
2,470	54.277	54.296	54.315	54.334	54.353	54.372	54.391	54.410	54.429	54.447	54.466	2,470
2,480	54.466	54.485	54.504	54.523	54.542	54.561	54.580	54.599	54.618	54.637	54.656	2,480
2,490	54.656	54.675	54.694	54.712	54.731	54.750	54.769	54.788	54.807	54.826	54.845	2,490
2,500	54.845											2,500
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A7.1.3. Type K thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature (°C) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius

Temperature Range (°C)	a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (μ V)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
-270 to 0	.....	..	3.9575518	+1	3.1063355	-2	-9.1607995	-5	3.0006628	-8	-1.1 to 1.2
-200 to 0	.....	..	3.9478446	+1	2.8256412	-2	-1.1488433	-4	-2.8153447	-8	-.08 to .05
-200 to 800	.....	..	3.6762217	+1	2.4544587	-2	-4.3081993	-5	2.5127588	-8	-180 to 200
- 20 to 500	.....	..	4.0999640	+1	-3.2619221	-3	8.5714137	-6	-1.6912373	-9	-25 to 45
0 to 400	.....	..	4.0981103	+1	-1.5992510	-4	-1.2525700	-5	3.2784725	-8	-25 to 20
0 to 1370	.....	..	3.9443859	+1	5.8953822	-3	-4.2015132	-6	1.3917059	-10	-60 to 110
400 to 1000	1.3223524	+3	3.0191663	+1	2.7508912	-2	-2.4734437	-5	6.9799332	-9	-.9 to 1.4
400 to 1370	-3.5456236	+1	3.8349319	+1	9.9993329	-3	-8.7444446	-6	1.7108618	-9	-12 to 11
600 to 800	2.1326086	+3	2.5608012	+1	3.7091744	-2	-3.3517324	-5	9.9607405	-9	-.05 to .07
850 to 1000	-9.0373549	+2	4.0577145	+1	9.5092149	-3	-1.0989249	-5	3.0753213	-9	-.05 to .03
1050 to 1150	-2.5972816	+3	5.2075276	+1	-1.4576419	-2	9.4854151	-6	-3.1178779	-9	-.05 to .05
II. Cubic Equation											
-270 to 0	.....	..	3.9458846	+1	2.8553429	-2	-1.0733611	-4	.....	..	-3 to 2
-200 to 0	.....	..	3.9523013	+1	2.9550516	-2	-1.0394181	-4	.....	..	-.4 to .5
-200 to 800	.....	..	3.5636003	+1	1.9650485	-2	-1.5602926	-5	.....	..	-250 to 400
- 20 to 500	.....	..	4.0960115	+1	-2.7895730	-3	6.9465824	-6	.....	..	-25 to 45
0 to 400	.....	..	4.1405218	+1	-6.2431359	-3	1.3032352	-5	.....	..	-35 to 25
0 to 1370	.....	..	3.9514688	+1	5.5954388	-3	-3.8312918	-6	.....	..	-65 to 110
400 to 1000	-5.6641071	+1	3.8903709	+1	7.6011228	-3	-5.1867039	-6	.....	..	-8 to 8
400 to 1370	-7.8572408	+2	4.2404631	+1	2.3321601	-3	-2.6773698	-6	.....	..	-25 to 18
600 to 800	-2.1824276	+2	3.9168943	+1	7.8581167	-3	-5.6043952	-6	.....	..	-.14 to .15
850 to 1000	-3.1416568	+3	5.0285062	+1	-6.2656016	-3	3.9088120	-7	.....	..	-.04 to .03
1050 to 1150	1.9581711	+3	3.5492848	+1	8.0515773	-3	-4.2332477	-6	.....	..	-.05 to .05
Variable reference junction	.....	..	.....	..	.....	..	.....	..	.....	..	.....
0 to 50	.....	..	3.9448872	+1	2.4548362	-2	-9.0918433	-5	.....	..	-0.06 to +0.14
III. Quadratic Equation											
-270 to 0	.....	..	4.2845408	+1	6.8763665	-2	.....	..	.....	..	-80 to 100
-200 to 0	.....	..	4.1360116	+1	5.8725165	-2	.....	..	.....	..	-30 to 35
-200 to 800	.....	..	3.7665390	+1	5.7515653	-3	.....	..	.....	..	-600 to 1500
- 20 to 500	.....	..	4.0201888	+1	2.0594884	-3	.....	..	.....	..	-40 to 70
0 to 400	.....	..	4.0501566	+1	9.8960972	-4	.....	..	.....	..	-40 to 45
0 to 1370	.....	..	4.2625178	+1	-1.6847755	-3	.....	..	.....	..	-450 to 350
400 to 1000	-1.6032853	+3	4.6193308	+1	-3.2869106	-3	.....	..	.....	..	-40 to 50
400 to 1370	-2.2148965	+3	4.8187566	+1	-4.7474730	-3	.....	..	.....	..	-90 to 100
600 to 800	-2.1041329	+3	4.7343554	+1	-3.8942290	-3	.....	..	.....	..	-1.6 to 1.6
850 to 1000	-2.8338815	+3	4.9283561	+1	-5.1810406	-3	.....	..	.....	..	-.06 to .06
1050 to 1150	-3.6676410	+3	5.0851682	+1	-5.9181402	-3	.....	..	.....	..	-.17 to .15
Variable reference junction correction	.....	..	.....	..	.....	..	.....	..	.....	..	.....
0 to 50	.....	..	3.9557007	+1	1.7584397	-2	.....	..	.....	..	-0.4 to +1.0

A7.2. Data for Temperature as a Function of Voltage

The temperature as a function of voltage data given in tables A7.2.1 and A7.2.2 were obtained by iteration in the primary equations for voltage as a function of temperature. Table A7.2.1 presents the data in millivolts from -6.45 mV to 54.87 mV with temperatures given in degrees Celsius while table A7.2.2 presents similar data with temperatures in degrees Fahrenheit. Table A7.2.3 contains quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges. The error range given in the table represents the difference between the temperature found by iteration in the full precision tables from the text and from the respective reduced order approximations.

TABLE A7.2.1. *Type K thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
-6.40	-249.25	-251.34	-253.67	-256.35	-259.58	-263.92						-6.40
-6.30	-234.32	-235.53	-236.79	-238.09	-239.45	-240.87	-242.35	-243.92	-245.57	-247.34	-249.25	-6.30
-6.20	-223.78	-224.73	-225.70	-226.69	-227.70	-228.73	-229.79	-230.88	-231.99	-233.14	-234.32	-6.20
-6.10	-215.08	-215.89	-216.71	-217.55	-218.40	-219.26	-220.13	-221.02	-221.92	-222.84	-223.78	-6.10
-6.00	-207.46	-208.18	-208.91	-209.66	-210.40	-211.16	-211.92	-212.70	-213.48	-214.27	-215.08	-6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.1. Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
-6.00	-207.46	-208.18	-208.91	-209.66	-210.40	-211.16	-211.92	-212.70	-213.48	-214.27	-215.08	-6.00
-5.90	-200.57	-201.23	-201.90	-202.57	-203.25	-203.94	-204.63	-205.32	-206.03	-206.74	-207.46	-5.90
-5.80	-194.22	-194.83	-195.45	-196.07	-196.70	-197.33	-197.97	-198.61	-199.26	-199.91	-200.57	-5.80
-5.70	-188.28	-188.86	-189.44	-190.02	-190.61	-191.20	-191.80	-192.40	-193.00	-193.60	-194.22	-5.70
-5.60	-182.68	-183.23	-183.78	-184.33	-184.88	-185.44	-186.00	-186.57	-187.14	-187.71	-188.28	-5.60
-5.50	-177.36	-177.88	-178.40	-178.93	-179.46	-179.99	-180.52	-181.06	-181.60	-182.14	-182.68	-5.50
-5.40	-172.28	-172.78	-173.28	-173.78	-174.28	-174.79	-175.30	-175.81	-176.33	-176.84	-177.36	-5.40
-5.30	-167.40	-167.88	-168.36	-168.84	-169.33	-169.81	-170.30	-170.79	-171.29	-171.78	-172.28	-5.30
-5.20	-162.70	-163.16	-163.62	-164.09	-164.56	-165.03	-165.50	-165.97	-166.44	-166.92	-167.40	-5.20
-5.10	-158.15	-158.60	-159.05	-159.50	-159.95	-160.41	-160.86	-161.32	-161.78	-162.24	-162.70	-5.10
-5.00	-153.75	-154.18	-154.62	-155.06	-155.50	-155.94	-156.38	-156.82	-157.26	-157.71	-158.15	-5.00
-4.90	-149.47	-149.90	-150.32	-150.74	-151.17	-151.60	-152.02	-152.45	-152.88	-153.32	-153.75	-4.90
-4.80	-145.31	-145.72	-146.13	-146.55	-146.96	-147.38	-147.79	-148.21	-148.63	-149.05	-149.47	-4.80
-4.70	-141.25	-141.65	-142.05	-142.46	-142.86	-143.27	-143.67	-144.08	-144.49	-144.90	-145.31	-4.70
-4.60	-137.29	-137.68	-138.07	-138.47	-138.86	-139.26	-139.65	-140.05	-140.45	-140.85	-141.25	-4.60
-4.50	-133.41	-133.79	-134.18	-134.56	-134.95	-135.34	-135.73	-136.11	-136.50	-136.89	-137.29	-4.50
-4.40	-129.61	-129.99	-130.37	-130.74	-131.12	-131.50	-131.88	-132.26	-132.64	-133.03	-133.41	-4.40
-4.30	-125.89	-126.26	-126.63	-127.00	-127.37	-127.74	-128.11	-128.49	-128.86	-129.24	-129.61	-4.30
-4.20	-122.24	-122.60	-122.96	-123.33	-123.69	-124.06	-124.42	-124.79	-125.15	-125.52	-125.89	-4.20
-4.10	-118.65	-119.01	-119.36	-119.72	-120.08	-120.44	-120.79	-121.15	-121.51	-121.88	-122.24	-4.10
-4.00	-115.12	-115.47	-115.82	-116.17	-116.53	-116.88	-117.23	-117.58	-117.94	-118.29	-118.65	-4.00
-3.90	-111.65	-111.99	-112.34	-112.68	-113.03	-113.38	-113.73	-114.07	-114.42	-114.77	-115.12	-3.90
-3.80	-108.23	-108.57	-108.91	-109.25	-109.59	-109.93	-110.28	-110.62	-110.96	-111.30	-111.65	-3.80
-3.70	-104.86	-105.20	-105.53	-105.87	-106.20	-106.54	-106.88	-107.21	-107.55	-107.89	-108.23	-3.70
-3.60	-101.54	-101.87	-102.20	-102.53	-102.86	-103.19	-103.53	-103.86	-104.19	-104.53	-104.86	-3.60
-3.50	-98.26	-98.59	-98.91	-99.24	-99.57	-99.89	-100.22	-100.55	-100.88	-101.21	-101.54	-3.50
-3.40	-95.02	-95.35	-95.67	-95.99	-96.31	-96.64	-96.96	-97.29	-97.61	-97.93	-98.26	-3.40
-3.30	-91.83	-92.15	-92.46	-92.78	-93.10	-93.42	-93.74	-94.06	-94.38	-94.70	-95.02	-3.30
-3.20	-88.67	-88.98	-89.30	-89.61	-89.93	-90.24	-90.56	-90.88	-91.19	-91.51	-91.83	-3.20
-3.10	-85.54	-85.86	-86.17	-86.48	-86.79	-87.10	-87.41	-87.73	-88.04	-88.35	-88.67	-3.10
-3.00	-82.46	-82.76	-83.07	-83.38	-83.69	-84.00	-84.31	-84.61	-84.92	-85.23	-85.54	-3.00
-2.90	-79.40	-79.70	-80.01	-80.31	-80.62	-80.92	-81.23	-81.53	-81.84	-82.15	-82.46	-2.90
-2.80	-76.37	-76.67	-76.97	-77.28	-77.58	-77.88	-78.18	-78.49	-78.79	-79.09	-79.40	-2.80
-2.70	-73.37	-73.67	-73.97	-74.27	-74.57	-74.87	-75.17	-75.47	-75.77	-76.07	-76.37	-2.70
-2.60	-70.40	-70.70	-71.00	-71.29	-71.59	-71.89	-72.18	-72.48	-72.78	-73.08	-73.37	-2.60
-2.50	-67.46	-67.76	-68.05	-68.34	-68.64	-68.93	-69.22	-69.52	-69.81	-70.11	-70.40	-2.50
-2.40	-64.55	-64.84	-65.13	-65.42	-65.71	-66.00	-66.29	-66.58	-66.88	-67.17	-67.46	-2.40
-2.30	-61.65	-61.94	-62.23	-62.52	-62.81	-63.10	-63.39	-63.67	-63.96	-64.25	-64.55	-2.30
-2.20	-58.78	-59.07	-59.35	-59.64	-59.93	-60.21	-60.50	-60.79	-61.08	-61.36	-61.65	-2.20
-2.10	-55.94	-56.22	-56.50	-56.79	-57.07	-57.36	-57.64	-57.93	-58.21	-58.50	-58.78	-2.10
-2.00	-53.11	-53.39	-53.67	-53.96	-54.24	-54.52	-54.80	-55.09	-55.37	-55.65	-55.94	-2.00
-1.90	-50.31	-50.58	-50.86	-51.14	-51.42	-51.71	-51.99	-52.27	-52.55	-52.83	-53.11	-1.90
-1.80	-47.52	-47.80	-48.08	-48.35	-48.63	-48.91	-49.19	-49.47	-49.75	-50.03	-50.31	-1.80
-1.70	-44.75	-45.03	-45.31	-45.58	-45.86	-46.13	-46.41	-46.69	-46.97	-47.24	-47.52	-1.70
-1.60	-42.01	-42.28	-42.55	-42.83	-43.10	-43.38	-43.65	-43.93	-44.20	-44.48	-44.75	-1.60
-1.50	-39.27	-39.55	-39.82	-40.09	-40.36	-40.64	-40.91	-41.18	-41.46	-41.73	-42.01	-1.50
-1.40	-36.56	-36.83	-37.10	-37.37	-37.64	-37.92	-38.19	-38.46	-38.73	-39.00	-39.27	-1.40
-1.30	-33.86	-34.13	-34.40	-34.67	-34.94	-35.21	-35.48	-35.75	-36.02	-36.29	-36.56	-1.30
-1.20	-31.18	-31.45	-31.71	-31.98	-32.25	-32.52	-32.79	-33.06	-33.32	-33.59	-33.86	-1.20
-1.10	-28.51	-28.78	-29.04	-29.31	-29.58	-29.84	-30.11	-30.38	-30.64	-30.91	-31.18	-1.10
-1.00	-25.86	-26.12	-26.39	-26.65	-26.92	-27.18	-27.45	-27.71	-27.98	-28.25	-28.51	-1.00
-0.90	-23.22	-23.48	-23.75	-24.01	-24.27	-24.54	-24.80	-25.07	-25.33	-25.59	-25.86	-0.90
-0.80	-20.59	-20.85	-21.12	-21.38	-21.64	-21.90	-22.17	-22.43	-22.69	-22.96	-23.22	-0.80
-0.70	-17.98	-18.24	-18.50	-18.76	-19.02	-19.28	-19.55	-19.81	-20.07	-20.33	-20.59	-0.70
-0.60	-15.38	-15.64	-15.90	-16.16	-16.42	-16.68	-16.94	-17.20	-17.46	-17.72	-17.98	-0.60
-0.50	-12.79	-13.05	-13.30	-13.56	-13.82	-14.08	-14.34	-14.60	-14.86	-15.12	-15.38	-0.50
-0.40	-10.21	-10.47	-10.72	-10.98	-11.24	-11.50	-11.76	-12.01	-12.27	-12.53	-12.79	-0.40
-0.30	-7.64	-7.90	-8.15	-8.41	-8.67	-8.92	-9.18	-9.44	-9.70	-9.95	-10.21	-0.30
-0.20	-5.08	-5.34	-5.60	-5.85	-6.11	-6.36	-6.62	-6.87	-7.13	-7.39	-7.64	-0.20
-0.10	-2.54	-2.79	-3.05	-3.30	-3.56	-3.81	-4.06	-4.32	-4.57	-4.83	-5.08	-0.10
-0.00	0.00	-0.25	-0.51	-0.76	-1.01	-1.27	-1.52	-1.78	-2.03	-2.28	-2.54	-0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.1. *Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
0.00	0.00	0.25	0.51	0.76	1.01	1.27	1.52	1.77	2.02	2.28	2.53	0.00
0.10	2.53	2.78	3.03	3.29	3.54	3.79	4.04	4.30	4.55	4.80	5.05	0.10
0.20	5.05	5.30	5.56	5.81	6.06	6.31	6.56	6.81	7.06	7.32	7.57	0.20
0.30	7.57	7.82	8.07	8.32	8.57	8.82	9.07	9.32	9.57	9.83	10.08	0.30
0.40	10.08	10.33	10.58	10.83	11.08	11.33	11.58	11.83	12.08	12.33	12.58	0.40
0.50	12.58	12.83	13.08	13.33	13.58	13.83	14.08	14.33	14.57	14.82	15.07	0.50
0.60	15.07	15.32	15.57	15.82	16.07	16.32	16.57	16.82	17.07	17.31	17.56	0.60
0.70	17.56	17.81	18.06	18.31	18.56	18.81	19.05	19.30	19.55	19.80	20.05	0.70
0.80	20.05	20.29	20.54	20.79	21.04	21.29	21.53	21.78	22.03	22.28	22.52	0.80
0.90	22.52	22.77	23.02	23.27	23.51	23.76	24.01	24.25	24.50	24.75	25.00	0.90
1.00	25.00	25.24	25.49	25.74	25.98	26.23	26.48	26.72	26.97	27.22	27.46	1.00
1.10	27.46	27.71	27.95	28.20	28.45	28.69	28.94	29.19	29.43	29.68	29.92	1.10
1.20	29.92	30.17	30.42	30.66	30.91	31.15	31.40	31.64	31.89	32.13	32.38	1.20
1.30	32.38	32.63	32.87	33.12	33.36	33.61	33.85	34.10	34.34	34.59	34.83	1.30
1.40	34.83	35.08	35.32	35.57	35.81	36.06	36.30	36.55	36.79	37.03	37.28	1.40
1.50	37.28	37.52	37.77	38.01	38.26	38.50	38.75	38.99	39.23	39.48	39.72	1.50
1.60	39.72	39.97	40.21	40.45	40.70	40.94	41.19	41.43	41.67	41.92	42.16	1.60
1.70	42.16	42.40	42.65	42.89	43.14	43.38	43.62	43.87	44.11	44.35	44.60	1.70
1.80	44.60	44.84	45.08	45.33	45.57	45.81	46.06	46.30	46.54	46.78	47.03	1.80
1.90	47.03	47.27	47.51	47.76	48.00	48.24	48.48	48.73	48.97	49.21	49.46	1.90
2.00	49.46	49.70	49.94	50.18	50.43	50.67	50.91	51.15	51.40	51.64	51.88	2.00
2.10	51.88	52.12	52.36	52.61	52.85	53.09	53.33	53.58	53.82	54.06	54.30	2.10
2.20	54.30	54.54	54.79	55.03	55.27	55.51	55.75	56.00	56.24	56.48	56.72	2.20
2.30	56.72	56.96	57.21	57.45	57.69	57.93	58.17	58.41	58.66	58.90	59.14	2.30
2.40	59.14	59.38	59.62	59.86	60.10	60.35	60.59	60.83	61.07	61.31	61.55	2.40
2.50	61.55	61.79	62.04	62.28	62.52	62.76	63.00	63.24	63.48	63.72	63.97	2.50
2.60	63.97	64.21	64.45	64.69	64.93	65.17	65.41	65.65	65.90	66.14	66.38	2.60
2.70	66.38	66.62	66.86	67.10	67.34	67.58	67.82	68.06	68.31	68.55	68.79	2.70
2.80	68.79	69.03	69.27	69.51	69.75	69.99	70.23	70.47	70.71	70.96	71.20	2.80
2.90	71.20	71.44	71.68	71.92	72.16	72.40	72.64	72.88	73.12	73.36	73.60	2.90
3.00	73.60	73.85	74.09	74.33	74.57	74.81	75.05	75.29	75.53	75.77	76.01	3.00
3.10	76.01	76.25	76.49	76.73	76.97	77.22	77.46	77.70	77.94	78.18	78.42	3.10
3.20	78.42	78.66	78.90	79.14	79.38	79.62	79.86	80.10	80.34	80.59	80.83	3.20
3.30	80.83	81.07	81.31	81.55	81.79	82.03	82.27	82.51	82.75	82.99	83.23	3.30
3.40	83.23	83.47	83.72	83.96	84.20	84.44	84.68	84.92	85.16	85.40	85.64	3.40
3.50	85.64	85.88	86.12	86.36	86.61	86.85	87.09	87.33	87.57	87.81	88.05	3.50
3.60	88.05	88.29	88.53	88.77	89.01	89.26	89.50	89.74	89.98	90.22	90.46	3.60
3.70	90.46	90.70	90.94	91.18	91.42	91.67	91.91	92.15	92.39	92.63	92.87	3.70
3.80	92.87	93.11	93.35	93.59	93.83	94.08	94.32	94.56	94.80	95.04	95.28	3.80
3.90	95.28	95.53	95.77	96.01	96.25	96.49	96.73	96.97	97.22	97.46	97.70	3.90
4.00	97.70	97.94	98.18	98.42	98.66	98.91	99.15	99.39	99.63	99.87	100.11	4.00
4.10	100.11	100.36	100.60	100.84	101.08	101.32	101.57	101.81	102.05	102.29	102.53	4.10
4.20	102.53	102.77	103.02	103.26	103.50	103.74	103.98	104.23	104.47	104.71	104.95	4.20
4.30	104.95	105.20	105.44	105.68	105.92	106.16	106.41	106.65	106.89	107.13	107.38	4.30
4.40	107.38	107.62	107.86	108.10	108.35	108.59	108.83	109.07	109.32	109.56	109.80	4.40
4.50	109.80	110.05	110.29	110.53	110.77	111.02	111.26	111.50	111.75	111.99	112.23	4.50
4.60	112.23	112.47	112.72	112.96	113.20	113.45	113.69	113.93	114.18	114.42	114.66	4.60
4.70	114.66	114.91	115.15	115.39	115.64	115.88	116.12	116.37	116.61	116.86	117.10	4.70
4.80	117.10	117.34	117.59	117.83	118.07	118.32	118.56	118.81	119.05	119.29	119.54	4.80
4.90	119.54	119.78	120.03	120.27	120.51	120.76	121.00	121.25	121.49	121.73	121.98	4.90
5.00	121.98	122.22	122.47	122.71	122.96	123.20	123.45	123.69	123.94	124.18	124.42	5.00
5.10	124.42	124.67	124.91	125.16	125.40	125.65	125.89	126.14	126.38	126.63	126.87	5.10
5.20	126.87	127.12	127.36	127.61	127.85	128.10	128.34	128.59	128.84	129.08	129.33	5.20
5.30	129.33	129.57	129.82	130.06	130.31	130.55	130.80	131.05	131.29	131.54	131.78	5.30
5.40	131.78	132.03	132.27	132.52	132.77	133.01	133.26	133.50	133.75	134.00	134.24	5.40
5.50	134.24	134.49	134.73	134.98	135.23	135.47	135.72	135.97	136.21	136.46	136.71	5.50
5.60	136.71	136.95	137.20	137.45	137.69	137.94	138.19	138.43	138.68	138.93	139.17	5.60
5.70	139.17	139.42	139.67	139.91	140.16	140.41	140.65	140.90	141.15	141.40	141.64	5.70
5.80	141.64	141.89	142.14	142.39	142.63	142.88	143.13	143.38	143.62	143.87	144.12	5.80
5.90	144.12	144.37	144.61	144.86	145.11	145.36	145.60	145.85	146.10	146.35	146.60	5.90
6.00	146.60	146.84	147.09	147.34	147.59	147.84	148.08	148.33	148.58	148.83	149.08	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.1. *Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
6.00	146.60	146.84	147.09	147.34	147.59	147.84	148.08	148.33	148.58	148.83	149.08	6.00
6.10	149.08	149.32	149.57	149.82	150.07	150.32	150.57	150.81	151.06	151.31	151.56	6.10
6.20	151.56	151.81	152.06	152.31	152.55	152.80	153.05	153.30	153.55	153.80	154.05	6.20
6.30	154.05	154.30	154.54	154.79	155.04	155.29	155.54	155.79	156.04	156.29	156.54	6.30
6.40	156.54	156.79	157.03	157.28	157.53	157.78	158.03	158.28	158.53	158.78	159.03	6.40
6.50	159.03	159.28	159.53	159.78	160.03	160.28	160.53	160.77	161.02	161.27	161.52	6.50
6.60	161.52	161.77	162.02	162.27	162.52	162.77	163.02	163.27	163.52	163.77	164.02	6.60
6.70	164.02	164.27	164.52	164.77	165.02	165.27	165.52	165.77	166.02	166.27	166.52	6.70
6.80	166.52	166.77	167.02	167.27	167.52	167.77	168.02	168.27	168.52	168.77	169.02	6.80
6.90	169.02	169.27	169.52	169.77	170.02	170.27	170.52	170.77	171.02	171.27	171.52	6.90
7.00	171.52	171.77	172.02	172.27	172.52	172.77	173.03	173.28	173.53	173.78	174.03	7.00
7.10	174.03	174.28	174.53	174.78	175.03	175.28	175.53	175.78	176.03	176.28	176.53	7.10
7.20	176.53	176.78	177.03	177.28	177.53	177.78	178.04	178.29	178.54	178.79	179.04	7.20
7.30	179.04	179.29	179.54	179.79	180.04	180.29	180.54	180.79	181.04	181.29	181.54	7.30
7.40	181.54	181.79	182.05	182.30	182.55	182.80	183.05	183.30	183.55	183.80	184.05	7.40
7.50	184.05	184.30	184.55	184.80	185.05	185.30	185.55	185.81	186.06	186.31	186.56	7.50
7.60	186.56	186.81	187.06	187.31	187.56	187.81	188.06	188.31	188.56	188.81	189.06	7.60
7.70	189.06	189.31	189.57	189.82	190.07	190.32	190.57	190.82	191.07	191.32	191.57	7.70
7.80	191.57	191.82	192.07	192.32	192.57	192.82	193.07	193.32	193.57	193.83	194.08	7.80
7.90	194.08	194.33	194.58	194.83	195.08	195.33	195.58	195.83	196.08	196.33	196.58	7.90
8.00	196.58	196.83	197.08	197.33	197.58	197.83	198.08	198.33	198.58	198.83	199.08	8.00
8.10	199.08	199.34	199.59	199.84	200.09	200.34	200.59	200.84	201.09	201.34	201.59	8.10
8.20	201.59	201.84	202.09	202.34	202.59	202.84	203.09	203.34	203.59	203.84	204.09	8.20
8.30	204.09	204.34	204.59	204.84	205.09	205.34	205.59	205.84	206.09	206.34	206.59	8.30
8.40	206.59	206.84	207.09	207.34	207.59	207.84	208.09	208.34	208.59	208.84	209.09	8.40
8.50	209.09	209.34	209.59	209.84	210.09	210.34	210.58	210.83	211.08	211.33	211.58	8.50
8.60	211.58	211.83	212.08	212.33	212.58	212.83	213.08	213.33	213.58	213.83	214.08	8.60
8.70	214.08	214.33	214.58	214.82	215.07	215.32	215.57	215.82	216.07	216.32	216.57	8.70
8.80	216.57	216.82	217.07	217.32	217.57	217.81	218.06	218.31	218.56	218.81	219.06	8.80
8.90	219.06	219.31	219.56	219.81	220.05	220.30	220.55	220.80	221.05	221.30	221.55	8.90
9.00	221.55	221.79	222.04	222.29	222.54	222.79	223.04	223.29	223.53	223.78	224.03	9.00
9.10	224.03	224.28	224.53	224.78	225.02	225.27	225.52	225.77	226.02	226.27	226.51	9.10
9.20	226.51	226.76	227.01	227.26	227.51	227.75	228.00	228.25	228.50	228.75	228.99	9.20
9.30	228.99	229.24	229.49	229.74	229.98	230.23	230.48	230.73	230.98	231.22	231.47	9.30
9.40	231.47	231.72	231.97	232.21	232.46	232.71	232.96	233.20	233.45	233.70	233.94	9.40
9.50	233.94	234.19	234.44	234.69	234.93	235.18	235.43	235.68	235.92	236.17	236.42	9.50
9.60	236.42	236.66	236.91	237.16	237.40	237.65	237.90	238.15	238.39	238.64	238.89	9.60
9.70	238.89	239.13	239.38	239.63	239.87	240.12	240.37	240.61	240.86	241.11	241.35	9.70
9.80	241.35	241.60	241.85	242.09	242.34	242.58	242.83	243.08	243.32	243.57	243.82	9.80
9.90	243.82	244.06	244.31	244.55	244.80	245.05	245.29	245.54	245.79	246.03	246.28	9.90
10.00	246.28	246.52	246.77	247.02	247.26	247.51	247.75	248.00	248.24	248.49	248.74	10.00
10.10	248.74	248.98	249.23	249.47	249.72	249.96	250.21	250.45	250.70	250.95	251.19	10.10
10.20	251.19	251.44	251.68	251.93	252.17	252.42	252.66	252.91	253.15	253.40	253.64	10.20
10.30	253.64	253.89	254.13	254.38	254.62	254.87	255.12	255.36	255.61	255.85	256.09	10.30
10.40	256.09	256.34	256.58	256.83	257.07	257.32	257.56	257.81	258.05	258.30	258.54	10.40
10.50	258.54	258.79	259.03	259.28	259.52	259.77	260.01	260.26	260.50	260.74	260.99	10.50
10.60	260.99	261.23	261.48	261.72	261.97	262.21	262.45	262.70	262.94	263.19	263.43	10.60
10.70	263.43	263.68	263.92	264.16	264.41	264.65	264.90	265.14	265.38	265.63	265.87	10.70
10.80	265.87	266.12	266.36	266.60	266.85	267.09	267.34	267.58	267.82	268.07	268.31	10.80
10.90	268.31	268.55	268.80	269.04	269.29	269.53	269.77	270.02	270.26	270.50	270.75	10.90
11.00	270.75	270.99	271.23	271.48	271.72	271.96	272.21	272.45	272.69	272.94	273.18	11.00
11.10	273.18	273.42	273.67	273.91	274.15	274.40	274.64	274.88	275.13	275.37	275.61	11.10
11.20	275.61	275.85	276.10	276.34	276.58	276.83	277.07	277.31	277.56	277.80	278.04	11.20
11.30	278.04	278.28	278.53	278.77	279.01	279.26	279.50	279.74	279.98	280.23	280.47	11.30
11.40	280.47	280.71	280.95	281.20	281.44	281.68	281.92	282.17	282.41	282.65	282.89	11.40
11.50	282.89	283.14	283.38	283.62	283.86	284.11	284.35	284.59	284.83	285.08	285.32	11.50
11.60	285.32	285.56	285.80	286.04	286.29	286.53	286.77	287.01	287.25	287.50	287.74	11.60
11.70	287.74	287.98	288.22	288.47	288.71	288.95	289.19	289.43	289.68	289.92	290.16	11.70
11.80	290.16	290.40	290.64	290.88	291.13	291.37	291.61	291.85	292.09	292.34	292.58	11.80
11.90	292.58	292.82	293.06	293.30	293.54	293.79	294.03	294.27	294.51	294.75	294.99	11.90
12.00	294.99	295.23	295.48	295.72	295.96	296.20	296.44	296.68	296.92	297.17	297.41	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.1. Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
12.00	294.99	295.23	295.48	295.72	295.96	296.20	296.44	296.68	296.92	297.17	297.41	12.00
12.10	297.41	297.65	297.89	298.13	298.37	298.61	298.86	299.10	299.34	299.58	299.82	12.10
12.20	299.82	300.06	300.30	300.54	300.79	301.03	301.27	301.51	301.75	301.99	302.23	12.20
12.30	302.23	302.47	302.71	302.95	303.20	303.44	303.68	303.92	304.16	304.40	304.64	12.30
12.40	304.64	304.88	305.12	305.36	305.61	305.85	306.09	306.33	306.57	306.81	307.05	12.40
12.50	307.05	307.29	307.53	307.77	308.01	308.25	308.49	308.74	308.98	309.22	309.46	12.50
12.60	309.46	309.70	309.94	310.18	310.42	310.66	310.90	311.14	311.38	311.62	311.86	12.60
12.70	311.86	312.10	312.34	312.58	312.82	313.06	313.31	313.55	313.79	314.03	314.27	12.70
12.80	314.27	314.51	314.75	314.99	315.23	315.47	315.71	315.95	316.19	316.43	316.67	12.80
12.90	316.67	316.91	317.15	317.39	317.63	317.87	318.11	318.35	318.59	318.83	319.07	12.90
13.00	319.07	319.31	319.55	319.79	320.03	320.27	320.51	320.75	320.99	321.23	321.47	13.00
13.10	321.47	321.71	321.95	322.19	322.43	322.67	322.91	323.15	323.39	323.63	323.87	13.10
13.20	323.87	324.11	324.35	324.59	324.83	325.07	325.31	325.55	325.79	326.03	326.27	13.20
13.30	326.27	326.51	326.75	326.99	327.23	327.47	327.71	327.95	328.19	328.42	328.66	13.30
13.40	328.66	328.90	329.14	329.38	329.62	329.86	330.10	330.34	330.58	330.82	331.06	13.40
13.50	331.06	331.30	331.54	331.78	332.02	332.26	332.50	332.74	332.98	333.22	333.45	13.50
13.60	333.45	333.69	333.93	334.17	334.41	334.65	334.89	335.13	335.37	335.61	335.85	13.60
13.70	335.85	336.09	336.33	336.57	336.80	337.04	337.28	337.52	337.76	338.00	338.24	13.70
13.80	338.24	338.48	338.72	338.96	339.20	339.44	339.67	339.91	340.15	340.39	340.63	13.80
13.90	340.63	340.87	341.11	341.35	341.59	341.83	342.07	342.30	342.54	342.78	343.02	13.90
14.00	343.02	343.26	343.50	343.74	343.98	344.22	344.45	344.69	344.93	345.17	345.41	14.00
14.10	345.41	345.65	345.89	346.13	346.37	346.60	346.84	347.08	347.32	347.56	347.80	14.10
14.20	347.80	348.04	348.28	348.51	348.75	348.99	349.23	349.47	349.71	349.95	350.19	14.20
14.30	350.19	350.42	350.66	350.90	351.14	351.38	351.62	351.86	352.09	352.33	352.57	14.30
14.40	352.57	352.81	353.05	353.29	353.53	353.76	354.00	354.24	354.48	354.72	354.96	14.40
14.50	354.96	355.20	355.43	355.67	355.91	356.15	356.39	356.63	356.86	357.10	357.34	14.50
14.60	357.34	357.58	357.82	358.06	358.29	358.53	358.77	359.01	359.25	359.49	359.72	14.60
14.70	359.72	359.96	360.20	360.44	360.68	360.92	361.15	361.39	361.63	361.87	362.11	14.70
14.80	362.11	362.34	362.58	362.82	363.06	363.30	363.54	363.77	364.01	364.25	364.49	14.80
14.90	364.49	364.73	364.96	365.20	365.44	365.68	365.92	366.15	366.39	366.63	366.87	14.90
15.00	366.87	367.11	367.34	367.58	367.82	368.06	368.30	368.53	368.77	369.01	369.25	15.00
15.10	369.25	369.49	369.72	369.96	370.20	370.44	370.68	370.91	371.15	371.39	371.63	15.10
15.20	371.63	371.86	372.10	372.34	372.58	372.82	373.05	373.29	373.53	373.77	374.00	15.20
15.30	374.00	374.24	374.48	374.72	374.96	375.19	375.43	375.67	375.91	376.14	376.38	15.30
15.40	376.38	376.62	376.86	377.09	377.33	377.57	377.81	378.05	378.28	378.52	378.76	15.40
15.50	378.76	379.00	379.23	379.47	379.71	379.95	380.18	380.42	380.66	380.90	381.13	15.50
15.60	381.13	381.37	381.61	381.85	382.08	382.32	382.56	382.80	383.03	383.27	383.51	15.60
15.70	383.51	383.75	383.98	384.22	384.46	384.70	384.93	385.17	385.41	385.64	385.88	15.70
15.80	385.88	386.12	386.36	386.59	386.83	387.07	387.31	387.54	387.78	388.02	388.25	15.80
15.90	388.25	388.49	388.73	388.97	389.20	389.44	389.68	389.92	390.15	390.39	390.63	15.90
16.00	390.63	390.86	391.10	391.34	391.58	391.81	392.05	392.29	392.52	392.76	393.00	16.00
16.10	393.00	393.24	393.47	393.71	393.95	394.18	394.42	394.66	394.89	395.13	395.37	16.10
16.20	395.37	395.61	395.84	396.08	396.32	396.55	396.79	397.03	397.26	397.50	397.74	16.20
16.30	397.74	397.98	398.21	398.45	398.69	398.92	399.16	399.40	399.63	399.87	400.11	16.30
16.40	400.11	400.34	400.58	400.82	401.06	401.29	401.53	401.77	402.00	402.24	402.48	16.40
16.50	402.48	402.71	402.95	403.19	403.42	403.66	403.90	404.13	404.37	404.61	404.84	16.50
16.60	404.84	405.08	405.32	405.55	405.79	406.03	406.26	406.50	406.74	406.97	407.21	16.60
16.70	407.21	407.45	407.68	407.92	408.16	408.39	408.63	408.87	409.10	409.34	409.58	16.70
16.80	409.58	409.81	410.05	410.29	410.52	410.76	411.00	411.23	411.47	411.71	411.94	16.80
16.90	411.94	412.18	412.41	412.65	412.89	413.12	413.36	413.60	413.83	414.07	414.31	16.90
17.00	414.31	414.54	414.78	415.02	415.25	415.49	415.72	415.96	416.20	416.43	416.67	17.00
17.10	416.67	416.91	417.14	417.38	417.62	417.85	418.09	418.32	418.56	418.80	419.03	17.10
17.20	419.03	419.27	419.51	419.74	419.98	420.22	420.45	420.69	420.92	421.16	421.40	17.20
17.30	421.40	421.63	421.87	422.10	422.34	422.58	422.81	423.05	423.29	423.52	423.76	17.30
17.40	423.76	423.99	424.23	424.47	424.70	424.94	425.18	425.41	425.65	425.88	426.12	17.40
17.50	426.12	426.36	426.59	426.83	427.06	427.30	427.54	427.77	428.01	428.24	428.48	17.50
17.60	428.48	428.72	428.95	429.19	429.42	429.66	429.90	430.13	430.37	430.60	430.84	17.60
17.70	430.84	431.08	431.31	431.55	431.78	432.02	432.26	432.49	432.73	432.96	433.20	17.70
17.80	433.20	433.44	433.67	433.91	434.14	434.38	434.61	434.85	435.09	435.32	435.56	17.80
17.90	435.56	435.79	436.03	436.27	436.50	436.74	436.97	437.21	437.44	437.68	437.92	17.90
18.00	437.92	438.15	438.39	438.62	438.86	439.10	439.33	439.57	439.80	440.04	440.27	18.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.1. Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
18.00	437.92	438.15	438.39	438.62	438.86	439.10	439.33	439.57	439.80	440.04	440.27	18.00
18.10	440.27	440.51	440.75	440.98	441.22	441.45	441.69	441.92	442.16	442.40	442.63	18.10
18.20	442.63	442.87	443.10	443.34	443.57	443.81	444.04	444.28	444.52	444.75	444.99	18.20
18.30	444.99	445.22	445.46	445.69	445.93	446.17	446.40	446.64	446.87	447.11	447.34	18.30
18.40	447.34	447.58	447.81	448.05	448.29	448.52	448.76	448.99	449.23	449.46	449.70	18.40
18.50	449.70	449.93	450.17	450.40	450.64	450.88	451.11	451.35	451.58	451.82	452.05	18.50
18.60	452.05	452.29	452.52	452.76	452.99	453.23	453.47	453.70	453.94	454.17	454.41	18.60
18.70	454.41	454.64	454.88	455.11	455.35	455.58	455.82	456.05	456.29	456.53	456.76	18.70
18.80	456.76	457.00	457.23	457.47	457.70	457.94	458.17	458.41	458.64	458.88	459.11	18.80
18.90	459.11	459.35	459.58	459.82	460.06	460.29	460.53	460.76	461.00	461.23	461.47	18.90
19.00	461.47	461.70	461.94	462.17	462.41	462.64	462.88	463.11	463.35	463.58	463.82	19.00
19.10	463.82	464.05	464.29	464.52	464.76	465.00	465.23	465.47	465.70	465.94	466.17	19.10
19.20	466.17	466.41	466.64	466.88	467.11	467.35	467.58	467.82	468.05	468.29	468.52	19.20
19.30	468.52	468.76	468.99	469.23	469.46	469.70	469.93	470.17	470.40	470.64	470.87	19.30
19.40	470.87	471.11	471.34	471.58	471.81	472.05	472.28	472.52	472.75	472.99	473.22	19.40
19.50	473.22	473.46	473.69	473.93	474.16	474.40	474.63	474.87	475.10	475.34	475.57	19.50
19.60	475.57	475.81	476.04	476.28	476.51	476.75	476.98	477.22	477.45	477.69	477.92	19.60
19.70	477.92	478.16	478.39	478.63	478.86	479.10	479.33	479.57	479.80	480.04	480.27	19.70
19.80	480.27	480.51	480.74	480.98	481.21	481.45	481.68	481.92	482.15	482.39	482.62	19.80
19.90	482.62	482.86	483.09	483.33	483.56	483.80	484.03	484.27	484.50	484.74	484.97	19.90
20.00	484.97	485.21	485.44	485.68	485.91	486.15	486.38	486.62	486.85	487.08	487.32	20.00
20.10	487.32	487.55	487.79	488.02	488.26	488.49	488.73	488.96	489.20	489.43	489.67	20.10
20.20	489.67	489.90	490.14	490.37	490.61	490.84	491.08	491.31	491.55	491.78	492.02	20.20
20.30	492.02	492.25	492.49	492.72	492.95	493.19	493.42	493.66	493.89	494.13	494.36	20.30
20.40	494.36	494.60	494.83	495.07	495.30	495.54	495.77	496.01	496.24	496.48	496.71	20.40
20.50	496.71	496.94	497.18	497.41	497.65	497.88	498.12	498.35	498.59	498.82	499.06	20.50
20.60	499.06	499.29	499.53	499.76	500.00	500.23	500.47	500.70	500.93	501.17	501.40	20.60
20.70	501.40	501.64	501.87	502.11	502.34	502.58	502.81	503.05	503.28	503.52	503.75	20.70
20.80	503.75	503.99	504.22	504.45	504.69	504.92	505.16	505.39	505.63	505.86	506.10	20.80
20.90	506.10	506.33	506.57	506.80	507.04	507.27	507.50	507.74	507.97	508.21	508.44	20.90
21.00	508.44	508.68	508.91	509.15	509.38	509.62	509.85	510.09	510.32	510.55	510.79	21.00
21.10	510.79	511.02	511.26	511.49	511.73	511.96	512.20	512.43	512.67	512.90	513.13	21.10
21.20	513.13	513.37	513.60	513.84	514.07	514.31	514.54	514.78	515.01	515.25	515.48	21.20
21.30	515.48	515.71	515.95	516.18	516.42	516.65	516.89	517.12	517.36	517.59	517.83	21.30
21.40	517.83	518.06	518.29	518.53	518.76	519.00	519.23	519.47	519.70	519.94	520.17	21.40
21.50	520.17	520.41	520.64	520.87	521.11	521.34	521.58	521.81	522.05	522.28	522.52	21.50
21.60	522.52	522.75	522.99	523.22	523.45	523.69	523.92	524.16	524.39	524.63	524.86	21.60
21.70	524.86	525.10	525.33	525.57	525.80	526.03	526.27	526.50	526.74	526.97	527.21	21.70
21.80	527.21	527.44	527.68	527.91	528.14	528.38	528.61	528.85	529.08	529.32	529.55	21.80
21.90	529.55	529.79	530.02	530.26	530.49	530.72	530.96	531.19	531.43	531.66	531.90	21.90
22.00	531.90	532.13	532.37	532.60	532.83	533.07	533.30	533.54	533.77	534.01	534.24	22.00
22.10	534.24	534.48	534.71	534.95	535.18	535.41	535.65	535.88	536.12	536.35	536.59	22.10
22.20	536.59	536.82	537.06	537.29	537.52	537.76	537.99	538.23	538.46	538.70	538.93	22.20
22.30	538.93	539.17	539.40	539.64	539.87	540.10	540.34	540.57	540.81	541.04	541.28	22.30
22.40	541.28	541.51	541.75	541.98	542.22	542.45	542.68	542.92	543.15	543.39	543.62	22.40
22.50	543.62	543.86	544.09	544.33	544.56	544.79	545.03	545.26	545.50	545.73	545.97	22.50
22.60	545.97	546.20	546.44	546.67	546.91	547.14	547.37	547.61	547.84	548.08	548.31	22.60
22.70	548.31	548.55	548.78	549.02	549.25	549.49	549.72	549.95	550.19	550.42	550.66	22.70
22.80	550.66	550.89	551.13	551.36	551.60	551.83	552.07	552.30	552.53	552.77	553.00	22.80
22.90	553.00	553.24	553.47	553.71	553.94	554.18	554.41	554.65	554.88	555.11	555.35	22.90
23.00	555.35	555.58	555.82	556.05	556.29	556.52	556.76	556.99	557.23	557.46	557.69	23.00
23.10	557.69	557.93	558.16	558.40	558.63	558.87	559.10	559.34	559.57	559.81	560.04	23.10
23.20	560.04	560.28	560.51	560.74	560.98	561.21	561.45	561.68	561.92	562.15	562.39	23.20
23.30	562.39	562.62	562.86	563.09	563.33	563.56	563.79	564.03	564.26	564.50	564.73	23.30
23.40	564.73	564.97	565.20	565.44	565.67	565.91	566.14	566.38	566.61	566.84	567.08	23.40
23.50	567.08	567.31	567.55	567.78	568.02	568.25	568.49	568.72	568.96	569.19	569.43	23.50
23.60	569.43	569.66	569.90	570.13	570.37	570.60	570.83	571.07	571.30	571.54	571.77	23.60
23.70	571.77	572.01	572.24	572.48	572.71	572.95	573.18	573.42	573.65	573.89	574.12	23.70
23.80	574.12	574.36	574.59	574.82	575.06	575.29	575.53	575.76	576.00	576.23	576.47	23.80
23.90	576.47	576.70	576.94	577.17	577.41	577.64	577.88	578.11	578.35	578.58	578.82	23.90
24.00	578.82	579.05	579.29	579.52	579.76	579.99	580.22	580.46	580.69	580.93	581.16	24.00

TABLE A7.2.1. *Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
24.00	578.82	579.05	579.29	579.52	579.76	579.99	580.22	580.46	580.69	580.93	581.16	24.00
24.10	581.16	581.40	581.63	581.87	582.10	582.34	582.57	582.81	583.04	583.28	583.51	24.10
24.20	583.51	583.75	583.98	584.22	584.45	584.69	584.92	585.16	585.39	585.63	585.86	24.20
24.30	585.86	586.10	586.33	586.57	586.80	587.04	587.27	587.51	587.74	587.98	588.21	24.30
24.40	588.21	588.45	588.68	588.92	589.15	589.39	589.62	589.86	590.09	590.33	590.56	24.40
24.50	590.56	590.79	591.03	591.26	591.50	591.73	591.97	592.20	592.44	592.67	592.91	24.50
24.60	592.91	593.14	593.38	593.61	593.85	594.09	594.32	594.56	594.79	595.03	595.26	24.60
24.70	595.26	595.50	595.73	595.97	596.20	596.44	596.67	596.91	597.14	597.38	597.61	24.70
24.80	597.61	597.85	598.08	598.32	598.55	598.79	599.02	599.26	599.49	599.73	599.96	24.80
24.90	599.96	600.20	600.43	600.67	600.90	601.14	601.37	601.61	601.84	602.08	602.31	24.90
25.00	602.31	602.55	602.78	603.02	603.25	603.49	603.73	603.96	604.20	604.43	604.67	25.00
25.10	604.67	604.90	605.14	605.37	605.61	605.84	606.08	606.31	606.55	606.78	607.02	25.10
25.20	607.02	607.25	607.49	607.72	607.96	608.20	608.43	608.67	608.90	609.14	609.37	25.20
25.30	609.37	609.61	609.84	610.08	610.31	610.55	610.78	611.02	611.25	611.49	611.73	25.30
25.40	611.73	611.96	612.20	612.43	612.67	612.90	613.14	613.37	613.61	613.84	614.08	25.40
25.50	614.08	614.32	614.55	614.79	615.02	615.26	615.49	615.73	615.96	616.20	616.43	25.50
25.60	616.43	616.67	616.91	617.14	617.38	617.61	617.85	618.08	618.32	618.55	618.79	25.60
25.70	618.79	619.03	619.26	619.50	619.73	619.97	620.20	620.44	620.67	620.91	621.15	25.70
25.80	621.15	621.38	621.62	621.85	622.09	622.32	622.56	622.80	623.03	623.27	623.50	25.80
25.90	623.50	623.74	623.97	624.21	624.45	624.68	624.92	625.15	625.39	625.62	625.86	25.90
26.00	625.86	626.10	626.33	626.57	626.80	627.04	627.27	627.51	627.75	627.98	628.22	26.00
26.10	628.22	628.45	628.69	628.93	629.16	629.40	629.63	629.87	630.10	630.34	630.58	26.10
26.20	630.58	630.81	631.05	631.28	631.52	631.76	631.99	632.23	632.46	632.70	632.94	26.20
26.30	632.94	633.17	633.41	633.64	633.88	634.12	634.35	634.59	634.82	635.06	635.30	26.30
26.40	635.30	635.53	635.77	636.00	636.24	636.48	636.71	636.95	637.18	637.42	637.66	26.40
26.50	637.66	637.89	638.13	638.36	638.60	638.84	639.07	639.31	639.54	639.78	640.02	26.50
26.60	640.02	640.25	640.49	640.73	640.96	641.20	641.43	641.67	641.91	642.14	642.38	26.60
26.70	642.38	642.62	642.85	643.09	643.32	643.56	643.80	644.03	644.27	644.51	644.74	26.70
26.80	644.74	644.98	645.21	645.45	645.69	645.92	646.16	646.40	646.63	646.87	647.11	26.80
26.90	647.11	647.34	647.58	647.81	648.05	648.29	648.52	648.76	649.00	649.23	649.47	26.90
27.00	649.47	649.71	649.94	650.18	650.42	650.65	650.89	651.12	651.36	651.60	651.83	27.00
27.10	651.83	652.07	652.31	652.54	652.78	653.02	653.25	653.49	653.73	653.96	654.20	27.10
27.20	654.20	654.44	654.67	654.91	655.15	655.38	655.62	655.86	656.09	656.33	656.57	27.20
27.30	656.57	656.80	657.04	657.28	657.51	657.75	657.99	658.22	658.46	658.70	658.93	27.30
27.40	658.93	659.17	659.41	659.65	659.88	660.12	660.36	660.59	660.83	661.07	661.30	27.40
27.50	661.30	661.54	661.78	662.01	662.25	662.49	662.72	662.96	663.20	663.44	663.67	27.50
27.60	663.67	663.91	664.15	664.38	664.62	664.86	665.09	665.33	665.57	665.81	666.04	27.60
27.70	666.04	666.28	666.52	666.75	666.99	667.23	667.46	667.70	667.94	668.18	668.41	27.70
27.80	668.41	668.65	668.89	669.12	669.36	669.60	669.84	670.07	670.31	670.55	670.79	27.80
27.90	670.79	671.02	671.26	671.50	671.73	671.97	672.21	672.45	672.68	672.92	673.16	27.90
28.00	673.16	673.40	673.63	673.87	674.11	674.35	674.58	674.82	675.06	675.29	675.53	28.00
28.10	675.53	675.77	676.01	676.24	676.48	676.72	676.96	677.19	677.43	677.67	677.91	28.10
28.20	677.91	678.14	678.38	678.62	678.86	679.09	679.33	679.57	679.81	680.04	680.28	28.20
28.30	680.28	680.52	680.76	681.00	681.23	681.47	681.71	681.95	682.18	682.42	682.66	28.30
28.40	682.66	682.90	683.13	683.37	683.61	683.85	684.09	684.32	684.56	684.80	685.04	28.40
28.50	685.04	685.27	685.51	685.75	685.99	686.23	686.46	686.70	686.94	687.18	687.42	28.50
28.60	687.42	687.65	687.89	688.13	688.37	688.61	688.84	689.08	689.32	689.56	689.80	28.60
28.70	689.80	690.03	690.27	690.51	690.75	690.99	691.22	691.46	691.70	691.94	692.18	28.70
28.80	692.18	692.41	692.65	692.89	693.13	693.37	693.61	693.84	694.08	694.32	694.56	28.80
28.90	694.56	694.80	695.03	695.27	695.51	695.75	695.99	696.23	696.46	696.70	696.94	28.90
29.00	696.94	697.18	697.42	697.66	697.89	698.13	698.37	698.61	698.85	699.09	699.32	29.00
29.10	699.32	699.56	699.80	700.04	700.28	700.52	700.76	700.99	701.23	701.47	701.71	29.10
29.20	701.71	701.95	702.19	702.43	702.66	702.90	703.14	703.38	703.62	703.86	704.10	29.20
29.30	704.10	704.33	704.57	704.81	705.05	705.29	705.53	705.77	706.01	706.24	706.48	29.30
29.40	706.48	706.72	706.96	707.20	707.44	707.68	707.92	708.15	708.39	708.63	708.87	29.40
29.50	708.87	709.11	709.35	709.59	709.83	710.07	710.30	710.54	710.78	711.02	711.26	29.50
29.60	711.26	711.50	711.74	711.98	712.22	712.46	712.70	712.93	713.17	713.41	713.65	29.60
29.70	713.65	713.89	714.13	714.37	714.61	714.85	715.09	715.33	715.56	715.80	716.04	29.70
29.80	716.04	716.28	716.52	716.76	717.00	717.24	717.48	717.72	717.96	718.20	718.44	29.80
29.90	718.44	718.68	718.91	719.15	719.39	719.63	719.87	720.11	720.35	720.59	720.83	29.90
30.00	720.83	721.07	721.31	721.55	721.79	722.03	722.27	722.51	722.75	722.99	723.23	30.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.1. Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
30.00	720.83	721.07	721.31	721.55	721.79	722.03	722.27	722.51	722.75	722.99	723.23	30.00
30.10	723.23	723.47	723.70	723.94	724.18	724.42	724.66	724.90	725.14	725.38	725.62	30.10
30.20	725.62	725.86	726.10	726.34	726.58	726.82	727.06	727.30	727.54	727.78	728.02	30.20
30.30	728.02	728.26	728.50	728.74	728.98	729.22	729.46	729.70	729.94	730.18	730.42	30.30
30.40	730.42	730.66	730.90	731.14	731.38	731.62	731.86	732.10	732.34	732.58	732.82	30.40
30.50	732.82	733.06	733.30	733.54	733.78	734.02	734.26	734.50	734.74	734.98	735.22	30.50
30.60	735.22	735.46	735.70	735.94	736.18	736.42	736.66	736.90	737.14	737.38	737.62	30.60
30.70	737.62	737.86	738.10	738.34	738.58	738.83	739.07	739.31	739.55	739.79	740.03	30.70
30.80	740.03	740.27	740.51	740.75	740.99	741.23	741.47	741.71	741.95	742.19	742.43	30.80
30.90	742.43	742.67	742.91	743.15	743.40	743.64	743.88	744.12	744.36	744.60	744.84	30.90
31.00	744.84	745.08	745.32	745.56	745.80	746.04	746.28	746.52	746.77	747.01	747.25	31.00
31.10	747.25	747.49	747.73	747.97	748.21	748.45	748.69	748.93	749.17	749.42	749.66	31.10
31.20	749.66	749.90	750.14	750.38	750.62	750.86	751.10	751.34	751.58	751.83	752.07	31.20
31.30	752.07	752.31	752.55	752.79	753.03	753.27	753.51	753.75	754.00	754.24	754.48	31.30
31.40	754.48	754.72	754.96	755.20	755.44	755.68	755.93	756.17	756.41	756.65	756.89	31.40
31.50	756.89	757.13	757.37	757.62	757.86	758.10	758.34	758.58	758.82	759.06	759.31	31.50
31.60	759.31	759.55	759.79	760.03	760.27	760.51	760.76	761.00	761.24	761.48	761.72	31.60
31.70	761.72	761.96	762.21	762.45	762.69	762.93	763.17	763.41	763.66	763.90	764.14	31.70
31.80	764.14	764.38	764.62	764.86	765.11	765.35	765.59	765.83	766.07	766.32	766.56	31.80
31.90	766.56	766.80	767.04	767.28	767.53	767.77	768.01	768.25	768.49	768.74	768.98	31.90
32.00	768.98	769.22	769.46	769.70	769.95	770.19	770.43	770.67	770.91	771.16	771.40	32.00
32.10	771.40	771.64	771.88	772.13	772.37	772.61	772.85	773.09	773.34	773.58	773.82	32.10
32.20	773.82	774.06	774.31	774.55	774.79	775.03	775.28	775.52	775.76	776.00	776.25	32.20
32.30	776.25	776.49	776.73	776.97	777.22	777.46	777.70	777.94	778.19	778.43	778.67	32.30
32.40	778.67	778.91	779.16	779.40	779.64	779.88	780.13	780.37	780.61	780.86	781.10	32.40
32.50	781.10	781.34	781.58	781.83	782.07	782.31	782.56	782.80	783.04	783.28	783.53	32.50
32.60	783.53	783.77	784.01	784.26	784.50	784.74	784.98	785.23	785.47	785.71	785.96	32.60
32.70	785.96	786.20	786.44	786.69	786.93	787.17	787.42	787.66	787.90	788.14	788.39	32.70
32.80	788.39	788.63	788.87	789.12	789.36	789.60	789.85	790.09	790.33	790.58	790.82	32.80
32.90	790.82	791.06	791.31	791.55	791.79	792.04	792.28	792.52	792.77	793.01	793.26	32.90
33.00	793.26	793.50	793.74	793.99	794.23	794.47	794.72	794.96	795.20	795.45	795.69	33.00
33.10	795.69	795.93	796.18	796.42	796.67	796.91	797.15	797.40	797.64	797.88	798.13	33.10
33.20	798.13	798.37	798.62	798.86	799.10	799.35	799.59	799.83	800.08	800.32	800.57	33.20
33.30	800.57	800.81	801.05	801.30	801.54	801.79	802.03	802.27	802.52	802.76	803.01	33.30
33.40	803.01	803.25	803.49	803.74	803.98	804.23	804.47	804.72	804.96	805.20	805.45	33.40
33.50	805.45	805.69	805.94	806.18	806.43	806.67	806.91	807.16	807.40	807.65	807.89	33.50
33.60	807.89	808.14	808.38	808.62	808.87	809.11	809.36	809.60	809.85	810.09	810.34	33.60
33.70	810.34	810.58	810.83	811.07	811.31	811.56	811.80	812.05	812.29	812.54	812.78	33.70
33.80	812.78	813.03	813.27	813.52	813.76	814.01	814.25	814.50	814.74	814.98	815.23	33.80
33.90	815.23	815.47	815.72	815.96	816.21	816.45	816.70	816.94	817.19	817.43	817.68	33.90
34.00	817.68	817.92	818.17	818.41	818.66	818.90	819.15	819.39	819.64	819.88	820.13	34.00
34.10	820.13	820.37	820.62	820.87	821.11	821.36	821.60	821.85	822.09	822.34	822.58	34.10
34.20	822.58	822.83	823.07	823.32	823.56	823.81	824.05	824.30	824.54	824.79	825.04	34.20
34.30	825.04	825.28	825.53	825.77	826.02	826.26	826.51	826.75	827.00	827.25	827.49	34.30
34.40	827.49	827.74	827.98	828.23	828.47	828.72	828.96	829.21	829.46	829.70	829.95	34.40
34.50	829.95	830.19	830.44	830.69	830.93	831.18	831.42	831.67	831.91	832.16	832.41	34.50
34.60	832.41	832.65	832.90	833.14	833.39	833.64	833.88	834.13	834.37	834.62	834.87	34.60
34.70	834.87	835.11	835.36	835.60	835.85	836.10	836.34	836.59	836.84	837.08	837.33	34.70
34.80	837.33	837.57	837.82	838.07	838.31	838.56	838.81	839.05	839.30	839.54	839.79	34.80
34.90	839.79	840.04	840.28	840.53	840.78	841.02	841.27	841.52	841.76	842.01	842.26	34.90
35.00	842.26	842.50	842.75	842.99	843.24	843.49	843.73	843.98	844.23	844.47	844.72	35.00
35.10	844.72	844.97	845.21	845.46	845.71	845.96	846.20	846.45	846.70	846.94	847.19	35.10
35.20	847.19	847.44	847.68	847.93	848.18	848.42	848.67	848.92	849.16	849.41	849.66	35.20
35.30	849.66	849.91	850.15	850.40	850.65	850.89	851.14	851.39	851.64	851.88	852.13	35.30
35.40	852.13	852.38	852.62	852.87	853.12	853.37	853.61	853.86	854.11	854.35	854.60	35.40
35.50	854.60	854.85	855.10	855.34	855.59	855.84	856.09	856.33	856.58	856.83	857.08	35.50
35.60	857.08	857.32	857.57	857.82	858.07	858.31	858.56	858.81	859.06	859.30	859.55	35.60
35.70	859.55	859.80	860.05	860.29	860.54	860.79	861.04	861.29	861.53	861.78	862.03	35.70
35.80	862.03	862.28	862.52	862.77	863.02	863.27	863.52	863.76	864.01	864.26	864.51	35.80
35.90	864.51	864.76	865.00	865.25	865.50	865.75	866.00	866.24	866.49	866.74	866.99	35.90
36.00	866.99	867.24	867.48	867.73	867.98	868.23	868.48	868.73	868.97	869.22	869.47	36.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.1. Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (1PTS 1968)												
36.00	866.99	867.24	867.48	867.73	867.98	868.23	868.48	868.73	868.97	869.22	869.47	36.00
36.10	869.47	869.72	869.97	870.22	870.46	870.71	870.96	871.21	871.46	871.71	871.95	36.10
36.20	871.95	872.20	872.45	872.70	872.95	873.20	873.45	873.69	873.94	874.19	874.44	36.20
36.30	874.44	874.69	874.94	875.19	875.43	875.68	875.93	876.18	876.43	876.68	876.93	36.30
36.40	876.93	877.18	877.42	877.67	877.92	878.17	878.42	878.67	878.92	879.17	879.41	36.40
36.50	879.41	879.66	879.91	880.16	880.41	880.66	880.91	881.16	881.41	881.66	881.90	36.50
36.60	881.90	882.15	882.40	882.65	882.90	883.15	883.40	883.65	883.90	884.15	884.40	36.60
36.70	884.40	884.65	884.90	885.14	885.39	885.64	885.89	886.14	886.39	886.64	886.89	36.70
36.80	886.89	887.14	887.39	887.64	887.89	888.14	888.39	888.64	888.89	889.14	889.39	36.80
36.90	889.39	889.63	889.88	890.13	890.38	890.63	890.88	891.13	891.38	891.63	891.88	36.90
37.00	891.88	892.13	892.38	892.63	892.88	893.13	893.38	893.63	893.88	894.13	894.38	37.00
37.10	894.38	894.63	894.88	895.13	895.38	895.63	895.88	896.13	896.38	896.63	896.88	37.10
37.20	896.88	897.13	897.38	897.63	897.88	898.13	898.38	898.63	898.88	899.13	899.38	37.20
37.30	899.38	899.63	899.88	900.13	900.38	900.63	900.88	901.13	901.38	901.63	901.88	37.30
37.40	901.88	902.13	902.39	902.64	902.89	903.14	903.39	903.64	903.89	904.14	904.39	37.40
37.50	904.39	904.64	904.89	905.14	905.39	905.64	905.89	906.14	906.39	906.65	906.90	37.50
37.60	906.90	907.15	907.40	907.65	907.90	908.15	908.40	908.65	908.90	909.15	909.40	37.60
37.70	909.40	909.65	909.91	910.16	910.41	910.66	910.91	911.16	911.41	911.66	911.91	37.70
37.80	911.91	912.16	912.42	912.67	912.92	913.17	913.42	913.67	913.92	914.17	914.42	37.80
37.90	914.42	914.68	914.93	915.18	915.43	915.68	915.93	916.18	916.44	916.69	916.94	37.90
38.00	916.94	917.19	917.44	917.69	917.94	918.20	918.45	918.70	918.95	919.20	919.45	38.00
38.10	919.45	919.70	919.96	920.21	920.46	920.71	920.96	921.21	921.47	921.72	921.97	38.10
38.20	921.97	922.22	922.47	922.72	922.98	923.23	923.48	923.73	923.98	924.23	924.49	38.20
38.30	924.49	924.74	924.99	925.24	925.49	925.75	926.00	926.25	926.50	926.75	927.01	38.30
38.40	927.01	927.26	927.51	927.76	928.01	928.27	928.52	928.77	929.02	929.28	929.53	38.40
38.50	929.53	929.78	930.03	930.28	930.54	930.79	931.04	931.29	931.55	931.80	932.05	38.50
38.60	932.05	932.30	932.56	932.81	933.06	933.31	933.57	933.82	934.07	934.32	934.58	38.60
38.70	934.58	934.83	935.08	935.33	935.59	935.84	936.09	936.34	936.60	936.85	937.10	38.70
38.80	937.10	937.35	937.61	937.86	938.11	938.37	938.62	938.87	939.12	939.38	939.63	38.80
38.90	939.63	939.88	940.13	940.39	940.64	940.89	941.15	941.40	941.65	941.91	942.16	38.90
39.00	942.16	942.41	942.66	942.92	943.17	943.42	943.68	943.93	944.18	944.44	944.69	39.00
39.10	944.69	944.94	945.20	945.45	945.70	945.96	946.21	946.46	946.72	946.97	947.22	39.10
39.20	947.22	947.48	947.73	947.98	948.24	948.49	948.74	949.00	949.25	949.50	949.76	39.20
39.30	949.76	950.01	950.26	950.52	950.77	951.03	951.28	951.53	951.79	952.04	952.29	39.30
39.40	952.29	952.55	952.80	953.05	953.31	953.56	953.82	954.07	954.32	954.58	954.83	39.40
39.50	954.83	955.09	955.34	955.59	955.85	956.10	956.36	956.61	956.86	957.12	957.37	39.50
39.60	957.37	957.63	957.88	958.13	958.39	958.64	958.90	959.15	959.40	959.66	959.91	39.60
39.70	959.91	960.17	960.42	960.68	960.93	961.18	961.44	961.69	961.95	962.20	962.46	39.70
39.80	962.46	962.71	962.96	963.22	963.47	963.73	963.98	964.24	964.49	964.75	965.00	39.80
39.90	965.00	965.25	965.51	965.76	966.02	966.27	966.53	966.78	967.04	967.29	967.55	39.90
40.00	967.55	967.80	968.06	968.31	968.57	968.82	969.07	969.33	969.58	969.84	970.09	40.00
40.10	970.09	970.35	970.60	970.86	971.11	971.37	971.62	971.88	972.13	972.39	972.64	40.10
40.20	972.64	972.90	973.15	973.41	973.66	973.92	974.17	974.43	974.68	974.94	975.20	40.20
40.30	975.20	975.45	975.71	975.96	976.22	976.47	976.73	976.98	977.24	977.49	977.75	40.30
40.40	977.75	978.00	978.26	978.51	978.77	979.03	979.28	979.54	979.79	980.05	980.30	40.40
40.50	980.30	980.56	980.81	981.07	981.33	981.58	981.84	982.09	982.35	982.60	982.86	40.50
40.60	982.86	983.12	983.37	983.63	983.88	984.14	984.39	984.65	984.91	985.16	985.42	40.60
40.70	985.42	985.67	985.93	986.19	986.44	986.70	986.95	987.21	987.47	987.72	987.98	40.70
40.80	987.98	988.23	988.49	988.75	989.00	989.26	989.51	989.77	990.03	990.28	990.54	40.80
40.90	990.54	990.80	991.05	991.31	991.56	991.82	992.08	992.33	992.59	992.85	993.10	40.90
41.00	993.10	993.36	993.62	993.87	994.13	994.39	994.64	994.90	995.16	995.41	995.67	41.00
41.10	995.67	995.92	996.18	996.44	996.69	996.95	997.21	997.46	997.72	997.98	998.24	41.10
41.20	998.24	998.49	998.75	999.01	999.26	999.52	999.78	1000.03	1000.29	1000.55	1000.80	41.20
41.30	1000.80	1001.06	1001.32	1001.57	1001.83	1002.09	1002.35	1002.60	1002.86	1003.12	1003.37	41.30
41.40	1003.37	1003.63	1003.89	1004.15	1004.40	1004.66	1004.92	1005.17	1005.43	1005.69	1005.95	41.40
41.50	1005.95	1006.20	1006.46	1006.72	1006.98	1007.23	1007.49	1007.75	1008.01	1008.26	1008.52	41.50
41.60	1008.52	1008.78	1009.04	1009.29	1009.55	1009.81	1010.07	1010.32	1010.58	1010.84	1011.10	41.60
41.70	1011.10	1011.35	1011.61	1011.87	1012.13	1012.38	1012.64	1012.90	1013.16	1013.42	1013.67	41.70
41.80	1013.67	1013.93	1014.19	1014.45	1014.70	1014.96	1015.22	1015.48	1015.74	1015.99	1016.25	41.80
41.90	1016.25	1016.51	1016.77	1017.03	1017.28	1017.54	1017.80	1018.06	1018.32	1018.58	1018.83	41.90
42.00	1018.83	1019.09	1019.35	1019.61	1019.87	1020.12	1020.38	1020.64	1020.90	1021.16	1021.42	42.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.1. Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
42.00	1018.83	1019.09	1019.35	1019.61	1019.87	1020.12	1020.38	1020.64	1020.90	1021.16	1021.42	42.00
42.10	1021.42	1021.67	1021.93	1022.19	1022.45	1022.71	1022.97	1023.23	1023.48	1023.74	1024.00	42.10
42.20	1024.00	1024.26	1024.52	1024.78	1025.04	1025.29	1025.55	1025.81	1026.07	1026.33	1026.59	42.20
42.30	1026.59	1026.85	1027.10	1027.36	1027.62	1027.88	1028.14	1028.40	1028.66	1028.92	1029.18	42.30
42.40	1029.18	1029.43	1029.69	1029.95	1030.21	1030.47	1030.73	1030.99	1031.25	1031.51	1031.77	42.40
42.50	1031.77	1032.02	1032.28	1032.54	1032.80	1033.06	1033.32	1033.58	1033.84	1034.10	1034.36	42.50
42.60	1034.36	1034.62	1034.88	1035.14	1035.39	1035.65	1035.91	1036.17	1036.43	1036.69	1036.95	42.60
42.70	1036.95	1037.21	1037.47	1037.73	1037.99	1038.25	1038.51	1038.77	1039.03	1039.29	1039.55	42.70
42.80	1039.55	1039.81	1040.07	1040.33	1040.59	1040.85	1041.10	1041.36	1041.62	1041.88	1042.14	42.80
42.90	1042.14	1042.40	1042.66	1042.92	1043.18	1043.44	1043.70	1043.96	1044.22	1044.48	1044.74	42.90
43.00	1044.74	1045.00	1045.26	1045.52	1045.78	1046.04	1046.30	1046.56	1046.82	1047.08	1047.34	43.00
43.10	1047.34	1047.60	1047.87	1048.13	1048.39	1048.65	1048.91	1049.17	1049.43	1049.69	1049.95	43.10
43.20	1049.95	1050.21	1050.47	1050.73	1050.99	1051.25	1051.51	1051.77	1052.03	1052.29	1052.55	43.20
43.30	1052.55	1052.81	1053.07	1053.33	1053.60	1053.86	1054.12	1054.38	1054.64	1054.90	1055.16	43.30
43.40	1055.16	1055.42	1055.68	1055.94	1056.20	1056.46	1056.72	1056.99	1057.25	1057.51	1057.77	43.40
43.50	1057.77	1058.03	1058.29	1058.55	1058.81	1059.07	1059.33	1059.60	1059.86	1060.12	1060.38	43.50
43.60	1060.38	1060.64	1060.90	1061.16	1061.42	1061.69	1061.95	1062.21	1062.47	1062.73	1062.99	43.60
43.70	1062.99	1063.25	1063.51	1063.78	1064.04	1064.30	1064.56	1064.82	1065.08	1065.34	1065.61	43.70
43.80	1065.61	1065.87	1066.13	1066.39	1066.65	1066.91	1067.18	1067.44	1067.70	1067.96	1068.22	43.80
43.90	1068.22	1068.48	1068.75	1069.01	1069.27	1069.53	1069.79	1070.06	1070.32	1070.58	1070.84	43.90
44.00	1070.84	1071.10	1071.37	1071.63	1071.89	1072.15	1072.41	1072.68	1072.94	1073.20	1073.46	44.00
44.10	1073.46	1073.72	1073.99	1074.25	1074.51	1074.77	1075.04	1075.30	1075.56	1075.82	1076.08	44.10
44.20	1076.08	1076.35	1076.61	1076.87	1077.13	1077.40	1077.66	1077.92	1078.18	1078.45	1078.71	44.20
44.30	1078.71	1078.97	1079.23	1079.50	1079.76	1080.02	1080.29	1080.55	1080.81	1081.07	1081.34	44.30
44.40	1081.34	1081.60	1081.86	1082.12	1082.39	1082.65	1082.91	1083.18	1083.44	1083.70	1083.96	44.40
44.50	1083.96	1084.23	1084.49	1084.75	1085.02	1085.28	1085.54	1085.81	1086.07	1086.33	1086.60	44.50
44.60	1086.60	1086.86	1087.12	1087.39	1087.65	1087.91	1088.18	1088.44	1088.70	1088.97	1089.23	44.60
44.70	1089.23	1089.49	1089.76	1090.02	1090.28	1090.55	1090.81	1091.07	1091.34	1091.60	1091.86	44.70
44.80	1091.86	1092.13	1092.39	1092.65	1092.92	1093.18	1093.45	1093.71	1093.97	1094.24	1094.50	44.80
44.90	1094.50	1094.76	1095.03	1095.29	1095.56	1095.82	1096.08	1096.35	1096.61	1096.88	1097.14	44.90
45.00	1097.14	1097.40	1097.67	1097.93	1098.20	1098.46	1098.72	1098.99	1099.25	1099.52	1099.78	45.00
45.10	1099.78	1100.05	1100.31	1100.57	1100.84	1101.10	1101.37	1101.63	1101.90	1102.16	1102.43	45.10
45.20	1102.43	1102.69	1102.95	1103.22	1103.48	1103.75	1104.01	1104.28	1104.54	1104.81	1105.07	45.20
45.30	1105.07	1105.34	1105.60	1105.87	1106.13	1106.39	1106.66	1106.92	1107.19	1107.45	1107.72	45.30
45.40	1107.72	1107.98	1108.25	1108.51	1108.78	1109.04	1109.31	1109.57	1109.84	1110.10	1110.37	45.40
45.50	1110.37	1110.63	1110.90	1111.16	1111.43	1111.70	1111.96	1112.23	1112.49	1112.76	1113.02	45.50
45.60	1113.02	1113.29	1113.55	1113.82	1114.08	1114.35	1114.61	1114.88	1115.15	1115.41	1115.68	45.60
45.70	1115.68	1115.94	1116.21	1116.47	1116.74	1117.00	1117.27	1117.54	1117.80	1118.07	1118.33	45.70
45.80	1118.33	1118.60	1118.87	1119.13	1119.40	1119.66	1119.93	1120.20	1120.46	1120.73	1120.99	45.80
45.90	1120.99	1121.26	1121.53	1121.79	1122.06	1122.32	1122.59	1122.86	1123.12	1123.39	1123.65	45.90
46.00	1123.65	1123.92	1124.19	1124.45	1124.72	1124.99	1125.25	1125.52	1125.79	1126.05	1126.32	46.00
46.10	1126.32	1126.59	1126.85	1127.12	1127.39	1127.65	1127.92	1128.19	1128.45	1128.72	1128.99	46.10
46.20	1128.99	1129.25	1129.52	1129.79	1130.05	1130.32	1130.59	1130.85	1131.12	1131.39	1131.65	46.20
46.30	1131.65	1131.92	1132.19	1132.46	1132.72	1132.99	1133.26	1133.52	1133.79	1134.06	1134.33	46.30
46.40	1134.33	1134.59	1134.86	1135.13	1135.39	1135.66	1135.93	1136.20	1136.46	1136.73	1137.00	46.40
46.50	1137.00	1137.27	1137.53	1137.80	1138.07	1138.34	1138.61	1138.87	1139.14	1139.41	1139.68	46.50
46.60	1139.68	1139.94	1140.21	1140.48	1140.75	1141.01	1141.28	1141.55	1141.82	1142.09	1142.35	46.60
46.70	1142.35	1142.62	1142.89	1143.16	1143.43	1143.69	1143.96	1144.23	1144.50	1144.77	1145.04	46.70
46.80	1145.04	1145.30	1145.57	1145.84	1146.11	1146.38	1146.65	1146.91	1147.18	1147.45	1147.72	46.80
46.90	1147.72	1147.99	1148.26	1148.53	1148.79	1149.06	1149.33	1149.60	1149.87	1150.14	1150.41	46.90
47.00	1150.41	1150.67	1150.94	1151.21	1151.48	1151.75	1152.02	1152.29	1152.56	1152.83	1153.10	47.00
47.10	1153.10	1153.36	1153.63	1153.90	1154.17	1154.44	1154.71	1154.98	1155.25	1155.52	1155.79	47.10
47.20	1155.79	1156.06	1156.33	1156.59	1156.86	1157.13	1157.40	1157.67	1157.94	1158.21	1158.48	47.20
47.30	1158.48	1158.75	1159.02	1159.29	1159.56	1159.83	1160.10	1160.37	1160.64	1160.91	1161.18	47.30
47.40	1161.18	1161.45	1161.72	1161.99	1162.26	1162.53	1162.80	1163.07	1163.34	1163.61	1163.88	47.40
47.50	1163.88	1164.15	1164.42	1164.69	1164.96	1165.23	1165.50	1165.77	1166.04	1166.31	1166.58	47.50
47.60	1166.58	1166.85	1167.12	1167.39	1167.66	1167.93	1168.20	1168.47	1168.74	1169.01	1169.29	47.60
47.70	1169.29	1169.56	1169.83	1170.10	1170.37	1170.64	1170.91	1171.18	1171.45	1171.72	1171.99	47.70
47.80	1171.99	1172.26	1172.53	1172.81	1173.08	1173.35	1173.62	1173.89	1174.16	1174.43	1174.70	47.80
47.90	1174.70	1174.98	1175.25	1175.52	1175.79	1176.06	1176.33	1176.60	1176.87	1177.15	1177.42	47.90
48.00	1177.42	1177.69	1177.96	1178.23	1178.50	1178.78	1179.05	1179.32	1179.59	1179.86	1180.13	48.00

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
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TABLE A7.2.1. Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
48.00	1177.42	1177.69	1177.96	1178.23	1178.50	1178.78	1179.05	1179.32	1179.59	1179.86	1180.13	48.00
48.10	1180.13	1180.41	1180.68	1180.95	1181.22	1181.49	1181.77	1182.04	1182.31	1182.58	1182.85	48.10
48.20	1182.85	1183.13	1183.40	1183.67	1183.94	1184.21	1184.49	1184.76	1185.03	1185.30	1185.58	48.20
48.30	1185.58	1185.85	1186.12	1186.39	1186.67	1186.94	1187.21	1187.48	1187.76	1188.03	1188.30	48.30
48.40	1188.30	1188.57	1188.85	1189.12	1189.39	1189.66	1189.94	1190.21	1190.48	1190.76	1191.03	48.40
48.50	1191.03	1191.30	1191.58	1191.85	1192.12	1192.39	1192.67	1192.94	1193.21	1193.49	1193.76	48.50
48.60	1193.76	1194.03	1194.31	1194.58	1194.85	1195.13	1195.40	1195.67	1195.95	1196.22	1196.49	48.60
48.70	1196.49	1196.77	1197.04	1197.32	1197.59	1197.86	1198.14	1198.41	1198.68	1198.96	1199.23	48.70
48.80	1199.23	1199.51	1199.78	1200.05	1200.33	1200.60	1200.88	1201.15	1201.42	1201.70	1201.97	48.80
48.90	1201.97	1202.25	1202.52	1202.80	1203.07	1203.34	1203.62	1203.89	1204.17	1204.44	1204.72	48.90
49.00	1204.72	1204.99	1205.27	1205.54	1205.81	1206.09	1206.36	1206.64	1206.91	1207.19	1207.46	49.00
49.10	1207.46	1207.74	1208.01	1208.29	1208.56	1208.84	1209.11	1209.39	1209.66	1209.94	1210.21	49.10
49.20	1210.21	1210.49	1210.76	1211.04	1211.31	1211.59	1211.86	1212.14	1212.42	1212.69	1212.97	49.20
49.30	1212.97	1213.24	1213.52	1213.79	1214.07	1214.34	1214.62	1214.90	1215.17	1215.45	1215.72	49.30
49.40	1215.72	1216.00	1216.27	1216.55	1216.83	1217.10	1217.38	1217.65	1217.93	1218.21	1218.48	49.40
49.50	1218.48	1218.76	1219.03	1219.31	1219.59	1219.86	1220.14	1220.42	1220.69	1220.97	1221.25	49.50
49.60	1221.25	1221.52	1221.80	1222.07	1222.35	1222.63	1222.90	1223.18	1223.46	1223.73	1224.01	49.60
49.70	1224.01	1224.29	1224.57	1224.84	1225.12	1225.40	1225.67	1225.95	1226.23	1226.50	1226.78	49.70
49.80	1226.78	1227.06	1227.34	1227.61	1227.89	1228.17	1228.44	1228.72	1229.00	1229.28	1229.55	49.80
49.90	1229.55	1229.83	1230.11	1230.39	1230.66	1230.94	1231.22	1231.50	1231.78	1232.05	1232.33	49.90
50.00	1232.33	1232.61	1232.89	1233.16	1233.44	1233.72	1234.00	1234.28	1234.55	1234.83	1235.11	50.00
50.10	1235.11	1235.39	1235.67	1235.95	1236.22	1236.50	1236.78	1237.06	1237.34	1237.62	1237.89	50.10
50.20	1237.89	1238.17	1238.45	1238.73	1239.01	1239.29	1239.57	1239.84	1240.12	1240.40	1240.68	50.20
50.30	1240.68	1240.96	1241.24	1241.52	1241.80	1242.08	1242.35	1242.63	1242.91	1243.19	1243.47	50.30
50.40	1243.47	1243.75	1244.03	1244.31	1244.59	1244.87	1245.15	1245.43	1245.71	1245.99	1246.27	50.40
50.50	1246.27	1246.54	1246.82	1247.10	1247.38	1247.66	1247.94	1248.22	1248.50	1248.78	1249.06	50.50
50.60	1249.06	1249.34	1249.62	1249.90	1250.18	1250.46	1250.74	1251.02	1251.30	1251.58	1251.86	50.60
50.70	1251.86	1252.14	1252.42	1252.70	1252.98	1253.27	1253.55	1253.83	1254.11	1254.39	1254.67	50.70
50.80	1254.67	1254.95	1255.23	1255.51	1255.79	1256.07	1256.35	1256.63	1256.91	1257.20	1257.48	50.80
50.90	1257.48	1257.76	1258.04	1258.32	1258.60	1258.88	1259.16	1259.44	1259.73	1260.01	1260.29	50.90
51.00	1260.29	1260.57	1260.85	1261.13	1261.41	1261.70	1261.98	1262.26	1262.54	1262.82	1263.10	51.00
51.10	1263.10	1263.39	1263.67	1263.95	1264.23	1264.51	1264.80	1265.08	1265.36	1265.64	1265.92	51.10
51.20	1265.92	1266.21	1266.49	1266.77	1267.05	1267.33	1267.62	1267.90	1268.18	1268.46	1268.75	51.20
51.30	1268.75	1269.03	1269.31	1269.59	1269.88	1270.16	1270.44	1270.72	1271.01	1271.29	1271.57	51.30
51.40	1271.57	1271.86	1272.14	1272.42	1272.70	1272.99	1273.27	1273.55	1273.84	1274.12	1274.40	51.40
51.50	1274.40	1274.69	1274.97	1275.25	1275.54	1275.82	1276.10	1276.39	1276.67	1276.95	1277.24	51.50
51.60	1277.24	1277.52	1277.80	1278.09	1278.37	1278.66	1278.94	1279.22	1279.51	1279.79	1280.07	51.60
51.70	1280.07	1280.36	1280.64	1280.93	1281.21	1281.50	1281.78	1282.06	1282.35	1282.63	1282.92	51.70
51.80	1282.92	1283.20	1283.49	1283.77	1284.05	1284.34	1284.62	1284.91	1285.19	1285.48	1285.76	51.80
51.90	1285.76	1286.05	1286.33	1286.62	1286.90	1287.19	1287.47	1287.76	1288.04	1288.33	1288.61	51.90
52.00	1288.61	1288.90	1289.18	1289.47	1289.75	1290.04	1290.32	1290.61	1290.89	1291.18	1291.46	52.00
52.10	1291.46	1291.75	1292.03	1292.32	1292.61	1292.89	1293.18	1293.46	1293.75	1294.03	1294.32	52.10
52.20	1294.32	1294.61	1294.89	1295.18	1295.46	1295.75	1296.04	1296.32	1296.61	1296.89	1297.18	52.20
52.30	1297.18	1297.47	1297.75	1298.04	1298.32	1298.61	1298.90	1299.18	1299.47	1299.76	1300.04	52.30
52.40	1300.04	1300.33	1300.62	1300.90	1301.19	1301.48	1301.76	1302.05	1302.34	1302.62	1302.91	52.40
52.50	1302.91	1303.20	1303.48	1303.77	1304.06	1304.35	1304.63	1304.92	1305.21	1305.49	1305.78	52.50
52.60	1305.78	1306.07	1306.36	1306.64	1306.93	1307.22	1307.51	1307.79	1308.08	1308.37	1308.66	52.60
52.70	1308.66	1308.94	1309.23	1309.52	1309.81	1310.10	1310.38	1310.67	1310.96	1311.25	1311.54	52.70
52.80	1311.54	1311.82	1312.11	1312.40	1312.69	1312.98	1313.26	1313.55	1313.84	1314.13	1314.42	52.80
52.90	1314.42	1314.71	1314.99	1315.28	1315.57	1315.86	1316.15	1316.44	1316.73	1317.01	1317.30	52.90
53.00	1317.30	1317.59	1317.88	1318.17	1318.46	1318.75	1319.04	1319.33	1319.61	1319.90	1320.19	53.00
53.10	1320.19	1320.48	1320.77	1321.06	1321.35	1321.64	1321.93	1322.22	1322.51	1322.80	1323.09	53.10
53.20	1323.09	1323.37	1323.66	1323.95	1324.24	1324.53	1324.82	1325.11	1325.40	1325.69	1325.98	53.20
53.30	1325.98	1326.27	1326.56	1326.85	1327.14	1327.43	1327.72	1328.01	1328.30	1328.59	1328.88	53.30
53.40	1328.88	1329.17	1329.46	1329.75	1330.04	1330.33	1330.62	1330.91	1331.20	1331.49	1331.78	53.40
53.50	1331.78	1332.07	1332.37	1332.66	1332.95	1333.24	1333.53	1333.82	1334.11	1334.40	1334.69	53.50
53.60	1334.69	1334.98	1335.27	1335.56	1335.85	1336.14	1336.44	1336.73	1337.02	1337.31	1337.60	53.60
53.70	1337.60	1337.89	1338.18	1338.47	1338.76	1339.06	1339.35	1339.64	1339.93	1340.22	1340.51	53.70
53.80	1340.51	1340.80	1341.10	1341.39	1341.68	1341.97	1342.26	1342.55	1342.85	1343.14	1343.43	53.80
53.90	1343.43	1343.72	1344.01	1344.30	1344.60	1344.89	1345.18	1345.47	1345.76	1346.06	1346.35	53.90
54.00	1346.35	1346.64	1346.93	1347.22	1347.52	1347.81	1348.10	1348.39	1348.69	1348.98	1349.27	54.00

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
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TABLE A7.2.1. *Type K thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPITS 1968)												
54.00	1346.35	1346.64	1346.93	1347.22	1347.52	1347.81	1348.10	1348.39	1348.69	1348.98	1349.27	54.00
54.10	1349.27	1349.56	1349.85	1350.15	1350.44	1350.73	1351.02	1351.32	1351.61	1351.90	1352.19	54.10
54.20	1352.19	1352.49	1352.78	1353.07	1353.37	1353.66	1353.95	1354.24	1354.54	1354.83	1355.12	54.20
54.30	1355.12	1355.41	1355.71	1356.00	1356.29	1356.59	1356.88	1357.17	1357.47	1357.76	1358.05	54.30
54.40	1358.05	1358.35	1358.64	1358.93	1359.22	1359.52	1359.81	1360.10	1360.40	1360.69	1360.98	54.40
54.50	1360.98	1361.28	1361.57	1361.87	1362.16	1362.45	1362.75	1363.04	1363.33	1363.63	1363.92	54.50
54.60	1363.92	1364.21	1364.51	1364.80	1365.09	1365.39	1365.68	1365.98	1366.27	1366.56	1366.86	54.60
54.70	1366.86	1367.15	1367.45	1367.74	1368.03	1368.33	1368.62	1368.91	1369.21	1369.50	1369.80	54.70
54.80	1369.80	1370.09	1370.39	1370.68	1370.97	1371.27	1371.56	1371.86				54.80
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. *Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
-6.40	-416.66	-420.42	-424.61	-429.43	-435.24	-443.05						-6.40
-6.30	-389.77	-391.96	-394.22	-396.57	-399.01	-401.56	-404.23	-407.05	-410.03	-413.22	-416.66	-6.30
-6.20	-370.80	-372.51	-374.26	-376.04	-377.86	-379.72	-381.63	-383.58	-385.58	-387.64	-389.77	-6.20
-6.10	-355.14	-356.60	-358.09	-359.59	-361.12	-362.67	-364.24	-365.84	-367.46	-369.11	-370.80	-6.10
-6.00	-341.42	-342.73	-344.05	-345.38	-346.73	-348.09	-349.46	-350.86	-352.27	-353.69	-355.14	-6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
-6.00	-341.42	-342.73	-344.05	-345.38	-346.73	-348.09	-349.46	-350.86	-352.27	-353.69	-355.14	-6.00
-5.90	-329.02	-330.21	-331.42	-332.63	-333.85	-335.08	-336.33	-337.58	-338.85	-340.13	-341.42	-5.90
-5.80	-317.59	-318.69	-319.81	-320.93	-322.06	-323.20	-324.35	-325.50	-326.67	-327.84	-329.02	-5.80
-5.70	-306.90	-307.94	-308.99	-310.04	-311.10	-312.16	-313.23	-314.31	-315.40	-316.49	-317.59	-5.70
-5.60	-296.83	-297.81	-298.80	-299.79	-300.79	-301.80	-302.81	-303.82	-304.84	-305.87	-306.90	-5.60
-5.50	-287.25	-288.19	-289.13	-290.07	-291.03	-291.98	-292.94	-293.90	-294.87	-295.85	-296.83	-5.50
-5.40	-278.10	-279.00	-279.90	-280.80	-281.71	-282.63	-283.54	-284.46	-285.39	-286.32	-287.25	-5.40
-5.30	-269.32	-270.18	-271.05	-271.92	-272.79	-273.67	-274.55	-275.43	-276.32	-277.21	-278.10	-5.30
-5.20	-260.85	-261.69	-262.52	-263.36	-264.20	-265.05	-265.90	-266.75	-267.60	-268.46	-269.32	-5.20
-5.10	-252.68	-253.48	-254.29	-255.10	-255.92	-256.73	-257.55	-258.37	-259.20	-260.02	-260.85	-5.10
-5.00	-244.75	-245.53	-246.32	-247.10	-247.89	-248.68	-249.48	-250.27	-251.07	-251.87	-252.68	-5.00
-4.90	-237.05	-237.81	-238.57	-239.34	-240.10	-240.87	-241.64	-242.42	-243.19	-243.97	-244.75	-4.90
-4.80	-229.56	-230.30	-231.04	-231.79	-232.53	-233.28	-234.03	-234.78	-235.54	-236.29	-237.05	-4.80
-4.70	-222.25	-222.97	-223.70	-224.42	-225.15	-225.88	-226.61	-227.35	-228.08	-228.82	-229.56	-4.70
-4.60	-215.11	-215.82	-216.53	-217.24	-217.95	-218.66	-219.38	-220.09	-220.81	-221.53	-222.25	-4.60
-4.50	-208.14	-208.83	-209.52	-210.21	-210.91	-211.61	-212.31	-213.01	-213.71	-214.41	-215.11	-4.50
-4.40	-201.30	-201.98	-202.66	-203.34	-204.02	-204.70	-205.39	-206.07	-206.76	-207.45	-208.14	-4.40
-4.30	-194.60	-195.27	-195.93	-196.60	-197.27	-197.94	-198.61	-199.28	-199.95	-200.63	-201.30	-4.30
-4.20	-188.03	-188.68	-189.33	-189.99	-190.64	-191.30	-191.96	-192.62	-193.28	-193.94	-194.60	-4.20
-4.10	-181.57	-182.21	-182.85	-183.49	-184.14	-184.78	-185.43	-186.08	-186.73	-187.38	-188.03	-4.10
-4.00	-175.22	-175.85	-176.48	-177.11	-177.75	-178.38	-179.02	-179.65	-180.29	-180.93	-181.57	-4.00
-3.90	-168.97	-169.59	-170.21	-170.83	-171.46	-172.08	-172.71	-173.33	-173.96	-174.59	-175.22	-3.90
-3.80	-162.81	-163.43	-164.04	-164.65	-165.26	-165.88	-166.50	-167.11	-167.73	-168.35	-168.97	-3.80
-3.70	-156.75	-157.35	-157.96	-158.56	-159.16	-159.77	-160.38	-160.99	-161.59	-162.20	-162.81	-3.70
-3.60	-150.77	-151.36	-151.96	-152.55	-153.15	-153.75	-154.35	-154.95	-155.55	-156.15	-156.75	-3.60
-3.50	-144.87	-145.46	-146.04	-146.63	-147.22	-147.81	-148.40	-148.99	-149.58	-150.18	-150.77	-3.50
-3.40	-139.04	-139.62	-140.20	-140.78	-141.36	-141.95	-142.53	-143.11	-143.70	-144.28	-144.87	-3.40
-3.30	-133.29	-133.86	-134.43	-135.01	-135.58	-136.16	-136.73	-137.31	-137.89	-138.46	-139.04	-3.30
-3.20	-127.60	-128.17	-128.73	-129.30	-129.87	-130.44	-131.01	-131.58	-132.15	-132.72	-133.29	-3.20
-3.10	-121.98	-122.54	-123.10	-123.66	-124.22	-124.78	-125.35	-125.91	-126.47	-127.04	-127.60	-3.10
-3.00	-116.42	-116.97	-117.53	-118.08	-118.64	-119.19	-119.75	-120.31	-120.86	-121.42	-121.98	-3.00
-2.90	-110.92	-111.46	-112.01	-112.56	-113.11	-113.66	-114.21	-114.76	-115.31	-115.87	-116.42	-2.90
-2.80	-105.47	-106.01	-106.55	-107.10	-107.64	-108.19	-108.73	-109.28	-109.82	-110.37	-110.92	-2.80
-2.70	-100.07	-100.61	-101.15	-101.69	-102.23	-102.76	-103.30	-103.84	-104.39	-104.93	-105.47	-2.70
-2.60	-94.73	-95.26	-95.79	-96.33	-96.86	-97.39	-97.93	-98.46	-99.00	-99.54	-100.07	-2.60
-2.50	-89.43	-89.96	-90.49	-91.02	-91.54	-92.07	-92.60	-93.13	-93.67	-94.20	-94.73	-2.50
-2.40	-84.18	-84.70	-85.23	-85.75	-86.28	-86.80	-87.33	-87.85	-88.38	-88.90	-89.43	-2.40
-2.30	-78.97	-79.49	-80.01	-80.53	-81.05	-81.57	-82.09	-82.61	-83.14	-83.66	-84.18	-2.30
-2.20	-73.81	-74.32	-74.84	-75.35	-75.87	-76.39	-76.90	-77.42	-77.94	-78.46	-78.97	-2.20
-2.10	-68.68	-69.20	-69.71	-70.22	-70.73	-71.24	-71.75	-72.27	-72.78	-73.30	-73.81	-2.10
-2.00	-63.60	-64.11	-64.61	-65.12	-65.63	-66.14	-66.65	-67.15	-67.66	-68.17	-68.68	-2.00
-1.90	-58.55	-59.05	-59.56	-60.06	-60.56	-61.07	-61.57	-62.08	-62.59	-63.09	-63.60	-1.90
-1.80	-53.54	-54.04	-54.54	-55.04	-55.54	-56.04	-56.54	-57.04	-57.54	-58.05	-58.55	-1.80
-1.70	-48.56	-49.05	-49.55	-50.05	-50.54	-51.04	-51.54	-52.04	-52.54	-53.04	-53.54	-1.70
-1.60	-43.61	-44.10	-44.60	-45.09	-45.58	-46.08	-46.57	-47.07	-47.56	-48.06	-48.56	-1.60
-1.50	-38.69	-39.18	-39.67	-40.17	-40.66	-41.15	-41.64	-42.13	-42.62	-43.12	-43.61	-1.50
-1.40	-33.81	-34.30	-34.78	-35.27	-35.76	-36.25	-36.74	-37.22	-37.71	-38.20	-38.69	-1.40
-1.30	-28.95	-29.44	-29.92	-30.41	-30.89	-31.38	-31.86	-32.35	-32.83	-33.32	-33.81	-1.30
-1.20	-24.12	-24.60	-25.09	-25.57	-26.05	-26.53	-27.02	-27.50	-27.98	-28.47	-28.95	-1.20
-1.10	-19.32	-19.80	-20.28	-20.76	-21.24	-21.72	-22.20	-22.68	-23.16	-23.64	-24.12	-1.10
-1.00	-14.55	-15.02	-15.50	-15.98	-16.45	-16.93	-17.41	-17.89	-18.36	-18.84	-19.32	-1.00
-0.90	-9.79	-10.27	-10.74	-11.22	-11.69	-12.17	-12.64	-13.12	-13.59	-14.07	-14.55	-0.90
-0.80	-5.07	-5.54	-6.01	-6.48	-6.95	-7.43	-7.90	-8.37	-8.85	-9.32	-9.79	-0.80
-0.70	-0.36	-0.83	-1.30	-1.77	-2.24	-2.71	-3.18	-3.65	-4.12	-4.59	-5.07	-0.70
-0.60	4.32	3.85	3.39	2.92	2.45	1.98	1.51	1.05	0.58	0.11	-0.36	-0.60
-0.50	8.98	8.52	8.05	7.59	7.12	6.65	6.19	5.72	5.25	4.79	4.32	-0.50
-0.40	13.62	13.16	12.70	12.23	11.77	11.30	10.84	10.38	9.91	9.45	8.98	-0.40
-0.30	18.24	17.78	17.32	16.86	16.40	15.94	15.47	15.01	14.55	14.09	13.62	-0.30
-0.20	22.85	22.39	21.93	21.47	21.01	20.55	20.09	19.63	19.17	18.71	18.24	-0.20
-0.10	27.43	26.97	26.52	26.06	25.60	25.14	24.68	24.22	23.77	23.31	22.85	-0.10
-0.00	32.00	31.54	31.09	30.63	30.17	29.72	29.26	28.80	28.35	27.89	27.43	-0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
0.00	32.00	32.46	32.91	33.37	33.82	34.28	34.73	35.19	35.64	36.10	36.55	0.00
0.10	36.55	37.01	37.46	37.92	38.37	38.82	39.28	39.73	40.19	40.64	41.09	0.10
0.20	41.09	41.55	42.00	42.45	42.91	43.36	43.81	44.26	44.72	45.17	45.62	0.20
0.30	45.62	46.07	46.53	46.98	47.43	47.88	48.33	48.78	49.23	49.69	50.14	0.30
0.40	50.14	50.59	51.04	51.49	51.94	52.39	52.84	53.29	53.74	54.19	54.64	0.40
0.50	54.64	55.09	55.54	55.99	56.44	56.89	57.34	57.79	58.23	58.68	59.13	0.50
0.60	59.13	59.58	60.03	60.48	60.93	61.37	61.82	62.27	62.72	63.17	63.61	0.60
0.70	63.61	64.06	64.51	64.95	65.40	65.85	66.30	66.74	67.19	67.64	68.08	0.70
0.80	68.08	68.53	68.98	69.42	69.87	70.31	70.76	71.21	71.65	72.10	72.54	0.80
0.90	72.54	72.99	73.43	73.88	74.32	74.77	75.21	75.66	76.10	76.55	76.99	0.90
1.00	76.99	77.44	77.88	78.33	78.77	79.21	79.66	80.10	80.54	80.99	81.43	1.00
1.10	81.43	81.88	82.32	82.76	83.21	83.65	84.09	84.53	84.98	85.42	85.86	1.10
1.20	85.86	86.31	86.75	87.19	87.63	88.07	88.52	88.96	89.40	89.84	90.28	1.20
1.30	90.28	90.73	91.17	91.61	92.05	92.49	92.93	93.37	93.82	94.26	94.70	1.30
1.40	94.70	95.14	95.58	96.02	96.46	96.90	97.34	97.78	98.22	98.66	99.10	1.40
1.50	99.10	99.54	99.98	100.42	100.86	101.30	101.74	102.18	102.62	103.06	103.50	1.50
1.60	103.50	103.94	104.38	104.82	105.26	105.70	106.13	106.57	107.01	107.45	107.89	1.60
1.70	107.89	108.33	108.77	109.21	109.64	110.08	110.52	110.96	111.40	111.83	112.27	1.70
1.80	112.27	112.71	113.15	113.59	114.02	114.46	114.90	115.34	115.77	116.21	116.65	1.80
1.90	116.65	117.09	117.52	117.96	118.40	118.84	119.27	119.71	120.15	120.58	121.02	1.90
2.00	121.02	121.46	121.89	122.33	122.77	123.20	123.64	124.08	124.51	124.95	125.38	2.00
2.10	125.38	125.82	126.26	126.69	127.13	127.56	128.00	128.44	128.87	129.31	129.74	2.10
2.20	129.74	130.18	130.62	131.05	131.49	131.92	132.36	132.79	133.23	133.66	134.10	2.20
2.30	134.10	134.53	134.97	135.40	135.84	136.27	136.71	137.14	137.58	138.01	138.45	2.30
2.40	138.45	138.88	139.32	139.75	140.19	140.62	141.06	141.49	141.93	142.36	142.80	2.40
2.50	142.80	143.23	143.66	144.10	144.53	144.97	145.40	145.84	146.27	146.70	147.14	2.50
2.60	147.14	147.57	148.01	148.44	148.88	149.31	149.74	150.18	150.61	151.05	151.48	2.60
2.70	151.48	151.91	152.35	152.78	153.21	153.65	154.08	154.52	154.95	155.38	155.82	2.70
2.80	155.82	156.25	156.68	157.12	157.55	157.99	158.42	158.85	159.29	159.72	160.15	2.80
2.90	160.15	160.59	161.02	161.45	161.89	162.32	162.75	163.19	163.62	164.05	164.49	2.90
3.00	164.49	164.92	165.35	165.79	166.22	166.65	167.09	167.52	167.95	168.39	168.82	3.00
3.10	168.82	169.25	169.69	170.12	170.55	170.99	171.42	171.85	172.29	172.72	173.15	3.10
3.20	173.15	173.59	174.02	174.45	174.89	175.32	175.75	176.19	176.62	177.05	177.49	3.20
3.30	177.49	177.92	178.35	178.79	179.22	179.65	180.09	180.52	180.95	181.39	181.82	3.30
3.40	181.82	182.25	182.69	183.12	183.55	183.99	184.42	184.85	185.29	185.72	186.16	3.40
3.50	186.16	186.59	187.02	187.46	187.89	188.32	188.76	189.19	189.62	190.06	190.49	3.50
3.60	190.49	190.92	191.36	191.79	192.23	192.66	193.09	193.53	193.96	194.39	194.83	3.60
3.70	194.83	195.26	195.70	196.13	196.56	197.00	197.43	197.87	198.30	198.73	199.17	3.70
3.80	199.17	199.60	200.04	200.47	200.91	201.34	201.77	202.21	202.64	203.08	203.51	3.80
3.90	203.51	203.95	204.38	204.81	205.25	205.68	206.12	206.55	206.99	207.42	207.86	3.90
4.00	207.86	208.29	208.73	209.16	209.60	210.03	210.47	210.90	211.34	211.77	212.21	4.00
4.10	212.21	212.64	213.08	213.51	213.95	214.38	214.82	215.25	215.69	216.12	216.56	4.10
4.20	216.56	216.99	217.43	217.87	218.30	218.74	219.17	219.61	220.04	220.48	220.92	4.20
4.30	220.92	221.35	221.79	222.22	222.66	223.10	223.53	223.97	224.41	224.84	225.28	4.30
4.40	225.28	225.71	226.15	226.59	227.02	227.46	227.90	228.33	228.77	229.21	229.64	4.40
4.50	229.64	230.08	230.52	230.96	231.39	231.83	232.27	232.70	233.14	233.58	234.02	4.50
4.60	234.02	234.45	234.89	235.33	235.77	236.21	236.64	237.08	237.52	237.96	238.39	4.60
4.70	238.39	238.83	239.27	239.71	240.15	240.59	241.02	241.46	241.90	242.34	242.78	4.70
4.80	242.78	243.22	243.66	244.09	244.53	244.97	245.41	245.85	246.29	246.73	247.17	4.80
4.90	247.17	247.61	248.05	248.49	248.92	249.36	249.80	250.24	250.68	251.12	251.56	4.90
5.00	251.56	252.00	252.44	252.88	253.32	253.76	254.20	254.64	255.08	255.52	255.96	5.00
5.10	255.96	256.40	256.85	257.29	257.73	258.17	258.61	259.05	259.49	259.93	260.37	5.10
5.20	260.37	260.81	261.26	261.70	262.14	262.58	263.02	263.46	263.90	264.35	264.79	5.20
5.30	264.79	265.23	265.67	266.11	266.55	267.00	267.44	267.88	268.32	268.77	269.21	5.30
5.40	269.21	269.65	270.09	270.54	270.98	271.42	271.86	272.31	272.75	273.19	273.64	5.40
5.50	273.64	274.08	274.52	274.97	275.41	275.85	276.30	276.74	277.18	277.63	278.07	5.50
5.60	278.07	278.51	278.96	279.40	279.85	280.29	280.73	281.18	281.62	282.07	282.51	5.60
5.70	282.51	282.96	283.40	283.84	284.29	284.73	285.18	285.62	286.07	286.51	286.96	5.70
5.80	286.96	287.40	287.85	288.29	288.74	289.18	289.63	290.08	290.52	290.97	291.41	5.80
5.90	291.41	291.86	292.30	292.75	293.19	293.64	294.09	294.53	294.98	295.42	295.87	5.90
6.00	295.87	296.32	296.76	297.21	297.66	298.10	298.55	299.00	299.44	299.89	300.34	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. *Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
6.00	295.87	296.32	296.76	297.21	297.66	298.10	298.55	299.00	299.44	299.89	300.34	6.00
6.10	300.34	300.78	301.23	301.68	302.12	302.57	303.02	303.47	303.91	304.36	304.81	6.10
6.20	304.81	305.25	305.70	306.15	306.60	307.05	307.49	307.94	308.39	308.84	309.28	6.20
6.30	309.28	309.73	310.18	310.63	311.08	311.52	311.97	312.42	312.87	313.32	313.77	6.30
6.40	313.77	314.21	314.66	315.11	315.56	316.01	316.46	316.91	317.35	317.80	318.25	6.40
6.50	318.25	318.70	319.15	319.60	320.05	320.50	320.95	321.39	321.84	322.29	322.74	6.50
6.60	322.74	323.19	323.64	324.09	324.54	324.99	325.44	325.89	326.34	326.79	327.24	6.60
6.70	327.24	327.69	328.14	328.59	329.04	329.49	329.94	330.39	330.84	331.29	331.74	6.70
6.80	331.74	332.19	332.64	333.09	333.54	333.99	334.44	334.89	335.34	335.79	336.24	6.80
6.90	336.24	336.69	337.14	337.59	338.04	338.49	338.94	339.39	339.84	340.29	340.74	6.90
7.00	340.74	341.19	341.64	342.09	342.54	342.99	343.45	343.90	344.35	344.80	345.25	7.00
7.10	345.25	345.70	346.15	346.60	347.05	347.50	347.95	348.40	348.86	349.31	349.76	7.10
7.20	349.76	350.21	350.66	351.11	351.56	352.01	352.46	352.91	353.37	353.82	354.27	7.20
7.30	354.27	354.72	355.17	355.62	356.07	356.52	356.97	357.43	357.88	358.33	358.78	7.30
7.40	358.78	359.23	359.68	360.13	360.58	361.03	361.49	361.94	362.39	362.84	363.29	7.40
7.50	363.29	363.74	364.19	364.64	365.10	365.55	366.00	366.45	366.90	367.35	367.80	7.50
7.60	367.80	368.25	368.71	369.16	369.61	370.06	370.51	370.96	371.41	371.86	372.32	7.60
7.70	372.32	372.77	373.22	373.67	374.12	374.57	375.02	375.47	375.92	376.38	376.83	7.70
7.80	376.83	377.28	377.73	378.18	378.63	379.08	379.53	379.98	380.43	380.89	381.34	7.80
7.90	381.34	381.79	382.24	382.69	383.14	383.59	384.04	384.49	384.94	385.40	385.85	7.90
8.00	385.85	386.30	386.75	387.20	387.65	388.10	388.55	389.00	389.45	389.90	390.35	8.00
8.10	390.35	390.80	391.25	391.70	392.16	392.61	393.06	393.51	393.96	394.41	394.86	8.10
8.20	394.86	395.31	395.76	396.21	396.66	397.11	397.56	398.01	398.46	398.91	399.36	8.20
8.30	399.36	399.81	400.26	400.71	401.16	401.61	402.06	402.51	402.96	403.41	403.86	8.30
8.40	403.86	404.31	404.76	405.21	405.66	406.11	406.56	407.01	407.46	407.91	408.36	8.40
8.50	408.36	408.81	409.26	409.70	410.15	410.60	411.05	411.50	411.95	412.40	412.85	8.50
8.60	412.85	413.30	413.75	414.20	414.65	415.09	415.54	415.99	416.44	416.89	417.34	8.60
8.70	417.34	417.79	418.24	418.68	419.13	419.58	420.03	420.48	420.93	421.38	421.82	8.70
8.80	421.82	422.27	422.72	423.17	423.62	424.07	424.51	424.96	425.41	425.86	426.31	8.80
8.90	426.31	426.75	427.20	427.65	428.10	428.54	428.99	429.44	429.89	430.34	430.78	8.90
9.00	430.78	431.23	431.68	432.13	432.57	433.02	433.47	433.91	434.36	434.81	435.26	9.00
9.10	435.26	435.70	436.15	436.60	437.04	437.49	437.94	438.38	438.83	439.28	439.72	9.10
9.20	439.72	440.17	440.62	441.06	441.51	441.96	442.40	442.85	443.30	443.74	444.19	9.20
9.30	444.19	444.63	445.08	445.53	445.97	446.42	446.86	447.31	447.76	448.20	448.65	9.30
9.40	448.65	449.09	449.54	449.98	450.43	450.87	451.32	451.77	452.21	452.66	453.10	9.40
9.50	453.10	453.55	453.99	454.44	454.88	455.33	455.77	456.22	456.66	457.11	457.55	9.50
9.60	457.55	457.99	458.44	458.88	459.33	459.77	460.22	460.66	461.11	461.55	461.99	9.60
9.70	461.99	462.44	462.88	463.33	463.77	464.22	464.66	465.10	465.55	465.99	466.43	9.70
9.80	466.43	466.88	467.32	467.77	468.21	468.65	469.10	469.54	469.98	470.43	470.87	9.80
9.90	470.87	471.31	471.76	472.20	472.64	473.08	473.53	473.97	474.41	474.86	475.30	9.90
10.00	475.30	475.74	476.18	476.63	477.07	477.51	477.95	478.40	478.84	479.28	479.72	10.00
10.10	479.72	480.17	480.61	481.05	481.49	481.93	482.38	482.82	483.26	483.70	484.14	10.10
10.20	484.14	484.59	485.03	485.47	485.91	486.35	486.79	487.24	487.68	488.12	488.56	10.20
10.30	488.56	489.00	489.44	489.88	490.32	490.77	491.21	491.65	492.09	492.53	492.97	10.30
10.40	492.97	493.41	493.85	494.29	494.73	495.17	495.62	496.06	496.50	496.94	497.38	10.40
10.50	497.38	497.82	498.26	498.70	499.14	499.58	500.02	500.46	500.90	501.34	501.78	10.50
10.60	501.78	502.22	502.66	503.10	503.54	503.98	504.42	504.86	505.30	505.74	506.18	10.60
10.70	506.18	506.62	507.06	507.50	507.93	508.37	508.81	509.25	509.69	510.13	510.57	10.70
10.80	510.57	511.01	511.45	511.89	512.33	512.76	513.20	513.64	514.08	514.52	514.96	10.80
10.90	514.96	515.40	515.84	516.27	516.71	517.15	517.59	518.03	518.47	518.91	519.34	10.90
11.00	519.34	519.78	520.22	520.66	521.10	521.53	521.97	522.41	522.85	523.29	523.72	11.00
11.10	523.72	524.16	524.60	525.04	525.48	525.91	526.35	526.79	527.23	527.66	528.10	11.10
11.20	528.10	528.54	528.98	529.41	529.85	530.29	530.73	531.16	531.60	532.04	532.47	11.20
11.30	532.47	532.91	533.35	533.79	534.22	534.66	535.10	535.53	535.97	536.41	536.84	11.30
11.40	536.84	537.28	537.72	538.15	538.59	539.03	539.46	539.90	540.34	540.77	541.21	11.40
11.50	541.21	541.65	542.08	542.52	542.95	543.39	543.83	544.26	544.70	545.14	545.57	11.50
11.60	545.57	546.01	546.44	546.88	547.32	547.75	548.19	548.62	549.06	549.49	549.93	11.60
11.70	549.93	550.37	550.80	551.24	551.67	552.11	552.54	552.98	553.42	553.85	554.29	11.70
11.80	554.29	554.72	555.16	555.59	556.03	556.46	556.90	557.33	557.77	558.20	558.64	11.80
11.90	558.64	559.07	559.51	559.94	560.38	560.81	561.25	561.68	562.12	562.55	562.99	11.90
12.00	562.99	563.42	563.86	564.29	564.73	565.16	565.60	566.03	566.46	566.90	567.33	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
12.00	562.99	563.42	563.86	564.29	564.73	565.16	565.60	566.03	566.46	566.90	567.33	12.00
12.10	567.33	567.77	568.20	568.64	569.07	569.51	569.94	570.37	570.81	571.24	571.68	12.10
12.20	571.68	572.11	572.55	572.98	573.41	573.85	574.28	574.72	575.15	575.58	576.02	12.20
12.30	576.02	576.45	576.89	577.32	577.75	578.19	578.62	579.05	579.49	579.92	580.36	12.30
12.40	580.36	580.79	581.22	581.66	582.09	582.52	582.96	583.39	583.82	584.26	584.69	12.40
12.50	584.69	585.12	585.56	585.99	586.42	586.86	587.29	587.72	588.16	588.59	589.02	12.50
12.60	589.02	589.46	589.89	590.32	590.75	591.19	591.62	592.05	592.49	592.92	593.35	12.60
12.70	593.35	593.79	594.22	594.65	595.08	595.52	595.95	596.38	596.81	597.25	597.68	12.70
12.80	597.68	598.11	598.55	598.98	599.41	599.84	600.28	600.71	601.14	601.57	602.00	12.80
12.90	602.00	602.44	602.87	603.30	603.73	604.17	604.60	605.03	605.46	605.90	606.33	12.90
13.00	606.33	606.76	607.19	607.62	608.06	608.49	608.92	609.35	609.78	610.22	610.65	13.00
13.10	610.65	611.08	611.51	611.94	612.38	612.81	613.24	613.67	614.10	614.53	614.97	13.10
13.20	614.97	615.40	615.83	616.26	616.69	617.12	617.56	617.99	618.42	618.85	619.28	13.20
13.30	619.28	619.71	620.15	620.58	621.01	621.44	621.87	622.30	622.73	623.16	623.60	13.30
13.40	623.60	624.03	624.46	624.89	625.32	625.75	626.18	626.61	627.05	627.48	627.91	13.40
13.50	627.91	628.34	628.77	629.20	629.63	630.06	630.49	630.93	631.36	631.79	632.22	13.50
13.60	632.22	632.65	633.08	633.51	633.94	634.37	634.80	635.23	635.66	636.10	636.53	13.60
13.70	636.53	636.96	637.39	637.82	638.25	638.68	639.11	639.54	639.97	640.40	640.83	13.70
13.80	640.83	641.26	641.69	642.12	642.55	642.98	643.41	643.84	644.28	644.71	645.14	13.80
13.90	645.14	645.57	646.00	646.43	646.86	647.29	647.72	648.15	648.58	649.01	649.44	13.90
14.00	649.44	649.87	650.30	650.73	651.16	651.59	652.02	652.45	652.88	653.31	653.74	14.00
14.10	653.74	654.17	654.60	655.03	655.46	655.89	656.32	656.75	657.18	657.61	658.04	14.10
14.20	658.04	658.47	658.90	659.33	659.76	660.19	660.62	661.04	661.47	661.90	662.33	14.20
14.30	662.33	662.76	663.19	663.62	664.05	664.48	664.91	665.34	665.77	666.20	666.63	14.30
14.40	666.63	667.06	667.49	667.92	668.35	668.78	669.21	669.63	670.06	670.49	670.92	14.40
14.50	670.92	671.35	671.78	672.21	672.64	673.07	673.50	673.93	674.36	674.78	675.21	14.50
14.60	675.21	675.64	676.07	676.50	676.93	677.36	677.79	678.22	678.65	679.07	679.50	14.60
14.70	679.50	679.93	680.36	680.79	681.22	681.65	682.08	682.51	682.93	683.36	683.79	14.70
14.80	683.79	684.22	684.65	685.08	685.51	685.94	686.36	686.79	687.22	687.65	688.08	14.80
14.90	688.08	688.51	688.94	689.36	689.79	690.22	690.65	691.08	691.51	691.93	692.36	14.90
15.00	692.36	692.79	693.22	693.65	694.08	694.51	694.93	695.36	695.79	696.22	696.65	15.00
15.10	696.65	697.07	697.50	697.93	698.36	698.79	699.22	699.64	700.07	700.50	700.93	15.10
15.20	700.93	701.36	701.78	702.21	702.64	703.07	703.50	703.92	704.35	704.78	705.21	15.20
15.30	705.21	705.64	706.06	706.49	706.92	707.35	707.78	708.20	708.63	709.06	709.49	15.30
15.40	709.49	709.92	710.34	710.77	711.20	711.63	712.05	712.48	712.91	713.34	713.76	15.40
15.50	713.76	714.19	714.62	715.05	715.48	715.90	716.33	716.76	717.19	717.61	718.04	15.50
15.60	718.04	718.47	718.90	719.32	719.75	720.18	720.61	721.03	721.46	721.89	722.31	15.60
15.70	722.31	722.74	723.17	723.60	724.02	724.45	724.88	725.31	725.73	726.16	726.59	15.70
15.80	726.59	727.01	727.44	727.87	728.30	728.72	729.15	729.58	730.00	730.43	730.86	15.80
15.90	730.86	731.29	731.71	732.14	732.57	732.99	733.42	733.85	734.27	734.70	735.13	15.90
16.00	735.13	735.56	735.98	736.41	736.84	737.26	737.69	738.12	738.54	738.97	739.40	16.00
16.10	739.40	739.82	740.25	740.68	741.10	741.53	741.96	742.38	742.81	743.24	743.66	16.10
16.20	743.66	744.09	744.52	744.94	745.37	745.80	746.22	746.65	747.08	747.50	747.93	16.20
16.30	747.93	748.36	748.78	749.21	749.64	750.06	750.49	750.91	751.34	751.77	752.19	16.30
16.40	752.19	752.62	753.05	753.47	753.90	754.33	754.75	755.18	755.60	756.03	756.46	16.40
16.50	756.46	756.88	757.31	757.74	758.16	758.59	759.01	759.44	759.87	760.29	760.72	16.50
16.60	760.72	761.14	761.57	762.00	762.42	762.85	763.27	763.70	764.13	764.55	764.98	16.60
16.70	764.98	765.40	765.83	766.26	766.68	767.11	767.53	767.96	768.39	768.81	769.24	16.70
16.80	769.24	769.66	770.09	770.52	770.94	771.37	771.79	772.22	772.64	773.07	773.50	16.80
16.90	773.50	773.92	774.35	774.77	775.20	775.62	776.05	776.47	776.90	777.33	777.75	16.90
17.00	777.75	778.18	778.60	779.03	779.45	779.88	780.30	780.73	781.16	781.58	782.01	17.00
17.10	782.01	782.43	782.86	783.28	783.71	784.13	784.56	784.98	785.41	785.84	786.26	17.10
17.20	786.26	786.69	787.11	787.54	787.96	788.39	788.81	789.24	789.66	790.09	790.51	17.20
17.30	790.51	790.94	791.36	791.79	792.21	792.64	793.06	793.49	793.91	794.34	794.76	17.30
17.40	794.76	795.19	795.61	796.04	796.46	796.89	797.32	797.74	798.17	798.59	799.02	17.40
17.50	799.02	799.44	799.86	800.29	800.71	801.14	801.56	801.99	802.41	802.84	803.26	17.50
17.60	803.26	803.69	804.11	804.54	804.96	805.39	805.81	806.24	806.66	807.09	807.51	17.60
17.70	807.51	807.94	808.36	808.79	809.21	809.64	810.06	810.48	810.91	811.33	811.76	17.70
17.80	811.76	812.18	812.61	813.03	813.46	813.88	814.31	814.73	815.16	815.58	816.00	17.80
17.90	816.00	816.43	816.85	817.28	817.70	818.13	818.55	818.98	819.40	819.82	820.25	17.90
18.00	820.25	820.67	821.10	821.52	821.95	822.37	822.80	823.22	823.64	824.07	824.49	18.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. *Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
18.00	820.25	820.67	821.10	821.52	821.95	822.37	822.80	823.22	823.64	824.07	824.49	18.00
18.10	824.49	824.92	825.34	825.77	826.19	826.61	827.04	827.46	827.89	828.31	828.74	18.10
18.20	828.74	829.16	829.58	830.01	830.43	830.86	831.28	831.70	832.13	832.55	832.98	18.20
18.30	832.98	833.40	833.83	834.25	834.67	835.10	835.52	835.95	836.37	836.79	837.22	18.30
18.40	837.22	837.64	838.07	838.49	838.91	839.34	839.76	840.19	840.61	841.03	841.46	18.40
18.50	841.46	841.88	842.30	842.73	843.15	843.58	844.00	844.42	844.85	845.27	845.70	18.50
18.60	845.70	846.12	846.54	846.97	847.39	847.81	848.24	848.66	849.09	849.51	849.93	18.60
18.70	849.93	850.36	850.78	851.20	851.63	852.05	852.48	852.90	853.32	853.75	854.17	18.70
18.80	854.17	854.59	855.02	855.44	855.86	856.29	856.71	857.14	857.56	857.98	858.41	18.80
18.90	858.41	858.83	859.25	859.68	860.10	860.52	860.95	861.37	861.79	862.22	862.64	18.90
19.00	862.64	863.06	863.49	863.91	864.33	864.76	865.18	865.60	866.03	866.45	866.87	19.00
19.10	866.87	867.30	867.72	868.14	868.57	868.99	869.41	869.84	870.26	870.68	871.11	19.10
19.20	871.11	871.53	871.95	872.38	872.80	873.22	873.65	874.07	874.49	874.92	875.34	19.20
19.30	875.34	875.76	876.19	876.61	877.03	877.46	877.88	878.30	878.73	879.15	879.57	19.30
19.40	879.57	880.00	880.42	880.84	881.27	881.69	882.11	882.53	882.96	883.38	883.80	19.40
19.50	883.80	884.23	884.65	885.07	885.50	885.92	886.34	886.76	887.19	887.61	888.03	19.50
19.60	888.03	888.46	888.88	889.30	889.73	890.15	890.57	890.99	891.42	891.84	892.26	19.60
19.70	892.26	892.69	893.11	893.53	893.96	894.38	894.80	895.22	895.65	896.07	896.49	19.70
19.80	896.49	896.92	897.34	897.76	898.18	898.61	899.03	899.45	899.88	900.30	900.72	19.80
19.90	900.72	901.14	901.57	901.99	902.41	902.83	903.26	903.68	904.10	904.53	904.95	19.90
20.00	904.95	905.37	905.79	906.22	906.64	907.06	907.48	907.91	908.33	908.75	909.18	20.00
20.10	909.18	909.60	910.02	910.44	910.87	911.29	911.71	912.13	912.56	912.98	913.40	20.10
20.20	913.40	913.82	914.25	914.67	915.09	915.52	915.94	916.36	916.78	917.21	917.63	20.20
20.30	917.63	918.05	918.47	918.90	919.32	919.74	920.16	920.59	921.01	921.43	921.85	20.30
20.40	921.85	922.28	922.70	923.12	923.54	923.97	924.39	924.81	925.23	925.66	926.08	20.40
20.50	926.08	926.50	926.92	927.35	927.77	928.19	928.61	929.04	929.46	929.88	930.30	20.50
20.60	930.30	930.73	931.15	931.57	931.99	932.42	932.84	933.26	933.68	934.10	934.53	20.60
20.70	934.53	934.95	935.37	935.79	936.22	936.64	937.06	937.48	937.91	938.33	938.75	20.70
20.80	938.75	939.17	939.60	940.02	940.44	940.86	941.28	941.71	942.13	942.55	942.97	20.80
20.90	942.97	943.40	943.82	944.24	944.66	945.09	945.51	945.93	946.35	946.77	947.20	20.90
21.00	947.20	947.62	948.04	948.46	948.89	949.31	949.73	950.15	950.58	951.00	951.42	21.00
21.10	951.42	951.84	952.26	952.69	953.11	953.53	953.95	954.38	954.80	955.22	955.64	21.10
21.20	955.64	956.06	956.49	956.91	957.33	957.75	958.18	958.60	959.02	959.44	959.86	21.20
21.30	959.86	960.29	960.71	961.13	961.55	961.98	962.40	962.82	963.24	963.66	964.09	21.30
21.40	964.09	964.51	964.93	965.35	965.77	966.20	966.62	967.04	967.46	967.89	968.31	21.40
21.50	968.31	968.73	969.15	969.57	970.00	970.42	970.84	971.26	971.69	972.11	972.53	21.50
21.60	972.53	972.95	973.37	973.80	974.22	974.64	975.06	975.48	975.91	976.33	976.75	21.60
21.70	976.75	977.17	977.60	978.02	978.44	978.86	979.28	979.71	980.13	980.55	980.97	21.70
21.80	980.97	981.39	981.82	982.24	982.66	983.08	983.50	983.93	984.35	984.77	985.19	21.80
21.90	985.19	985.62	986.04	986.46	986.88	987.30	987.73	988.15	988.57	988.99	989.41	21.90
22.00	989.41	989.84	990.26	990.68	991.10	991.52	991.95	992.37	992.79	993.21	993.64	22.00
22.10	993.64	994.06	994.48	994.90	995.32	995.75	996.17	996.59	997.01	997.43	997.86	22.10
22.20	997.86	998.28	998.70	999.12	999.54	999.97	1000.39	1000.81	1001.23	1001.66	1002.08	22.20
22.30	1002.08	1002.50	1002.92	1003.34	1003.77	1004.19	1004.61	1005.03	1005.45	1005.88	1006.30	22.30
22.40	1006.30	1006.72	1007.14	1007.56	1007.99	1008.41	1008.83	1009.25	1009.68	1010.10	1010.52	22.40
22.50	1010.52	1010.94	1011.36	1011.79	1012.21	1012.63	1013.05	1013.47	1013.90	1014.32	1014.74	22.50
22.60	1014.74	1015.16	1015.59	1016.01	1016.43	1016.85	1017.27	1017.70	1018.12	1018.54	1018.96	22.60
22.70	1018.96	1019.38	1019.81	1020.23	1020.65	1021.07	1021.50	1021.92	1022.34	1022.76	1023.18	22.70
22.80	1023.18	1023.61	1024.03	1024.45	1024.87	1025.30	1025.72	1026.14	1026.56	1026.98	1027.41	22.80
22.90	1027.41	1027.83	1028.25	1028.67	1029.09	1029.52	1029.94	1030.36	1030.78	1031.21	1031.63	22.90
23.00	1031.63	1032.05	1032.47	1032.89	1033.32	1033.74	1034.16	1034.58	1035.01	1035.43	1035.85	23.00
23.10	1035.85	1036.27	1036.70	1037.12	1037.54	1037.96	1038.38	1038.81	1039.23	1039.65	1040.07	23.10
23.20	1040.07	1040.50	1040.92	1041.34	1041.76	1042.18	1042.61	1043.03	1043.45	1043.87	1044.30	23.20
23.30	1044.30	1044.72	1045.14	1045.56	1045.99	1046.41	1046.83	1047.25	1047.67	1048.10	1048.52	23.30
23.40	1048.52	1048.94	1049.36	1049.79	1050.21	1050.63	1051.05	1051.48	1051.90	1052.32	1052.74	23.40
23.50	1052.74	1053.17	1053.59	1054.01	1054.43	1054.86	1055.28	1055.70	1056.12	1056.54	1056.97	23.50
23.60	1056.97	1057.39	1057.81	1058.23	1058.66	1059.08	1059.50	1059.92	1060.35	1060.77	1061.19	23.60
23.70	1061.19	1061.61	1062.04	1062.46	1062.88	1063.30	1063.73	1064.15	1064.57	1064.99	1065.42	23.70
23.80	1065.42	1065.84	1066.26	1066.68	1067.11	1067.53	1067.95	1068.37	1068.80	1069.22	1069.64	23.80
23.90	1069.64	1070.07	1070.49	1070.91	1071.33	1071.76	1072.18	1072.60	1073.02	1073.45	1073.87	23.90
24.00	1073.87	1074.29	1074.71	1075.14	1075.56	1075.98	1076.40	1076.83	1077.25	1077.67	1078.10	24.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. *Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
24.00	1073.87	1074.29	1074.71	1075.14	1075.56	1075.98	1076.40	1076.83	1077.25	1077.67	1078.10	24.00
24.10	1078.10	1078.52	1078.94	1079.36	1079.79	1080.21	1080.63	1081.05	1081.48	1081.90	1082.32	24.10
24.20	1082.32	1082.75	1083.17	1083.59	1084.01	1084.44	1084.86	1085.28	1085.70	1086.13	1086.55	24.20
24.30	1086.55	1086.97	1087.40	1087.82	1088.24	1088.66	1089.09	1089.51	1089.93	1090.36	1090.78	24.30
24.40	1090.78	1091.20	1091.62	1092.05	1092.47	1092.89	1093.32	1093.74	1094.16	1094.59	1095.01	24.40
24.50	1095.01	1095.43	1095.85	1096.28	1096.70	1097.12	1097.55	1097.97	1098.39	1098.81	1099.24	24.50
24.60	1099.24	1099.66	1100.08	1100.51	1100.93	1101.35	1101.78	1102.20	1102.62	1103.05	1103.47	24.60
24.70	1103.47	1103.89	1104.31	1104.74	1105.16	1105.58	1106.01	1106.43	1106.85	1107.28	1107.70	24.70
24.80	1107.70	1108.12	1108.55	1108.97	1109.39	1109.82	1110.24	1110.66	1111.09	1111.51	1111.93	24.80
24.90	1111.93	1112.36	1112.78	1113.20	1113.63	1114.05	1114.47	1114.90	1115.32	1115.74	1116.17	24.90
25.00	1116.17	1116.59	1117.01	1117.44	1117.86	1118.28	1118.71	1119.13	1119.55	1119.98	1120.40	25.00
25.10	1120.40	1120.82	1121.25	1121.67	1122.09	1122.52	1122.94	1123.36	1123.79	1124.21	1124.63	25.10
25.20	1124.63	1125.06	1125.48	1125.90	1126.33	1126.75	1127.18	1127.60	1128.02	1128.45	1128.87	25.20
25.30	1128.87	1129.29	1129.72	1130.14	1130.56	1130.99	1131.41	1131.84	1132.26	1132.68	1133.11	25.30
25.40	1133.11	1133.53	1133.95	1134.38	1134.80	1135.22	1135.65	1136.07	1136.50	1136.92	1137.34	25.40
25.50	1137.34	1137.77	1138.19	1138.62	1139.04	1139.46	1139.89	1140.31	1140.73	1141.16	1141.58	25.50
25.60	1141.58	1142.01	1142.43	1142.85	1143.28	1143.70	1144.13	1144.55	1144.97	1145.40	1145.82	25.60
25.70	1145.82	1146.25	1146.67	1147.09	1147.52	1147.94	1148.37	1148.79	1149.21	1149.64	1150.06	25.70
25.80	1150.06	1150.49	1150.91	1151.34	1151.76	1152.18	1152.61	1153.03	1153.46	1153.88	1154.30	25.80
25.90	1154.30	1154.73	1155.15	1155.58	1156.00	1156.43	1156.85	1157.27	1157.70	1158.12	1158.55	25.90
26.00	1158.55	1158.97	1159.40	1159.82	1160.25	1160.67	1161.09	1161.52	1161.94	1162.37	1162.79	26.00
26.10	1162.79	1163.22	1163.64	1164.07	1164.49	1164.91	1165.34	1165.76	1166.19	1166.61	1167.04	26.10
26.20	1167.04	1167.46	1167.89	1168.31	1168.74	1169.16	1169.58	1170.01	1170.43	1170.86	1171.28	26.20
26.30	1171.28	1171.71	1172.13	1172.56	1172.98	1173.41	1173.83	1174.26	1174.68	1175.11	1175.53	26.30
26.40	1175.53	1175.96	1176.38	1176.81	1177.23	1177.66	1178.08	1178.51	1178.93	1179.36	1179.78	26.40
26.50	1179.78	1180.21	1180.63	1181.06	1181.48	1181.91	1182.33	1182.76	1183.18	1183.61	1184.03	26.50
26.60	1184.03	1184.46	1184.88	1185.31	1185.73	1186.16	1186.58	1187.01	1187.43	1187.86	1188.28	26.60
26.70	1188.28	1188.71	1189.13	1189.56	1189.98	1190.41	1190.83	1191.26	1191.68	1192.11	1192.54	26.70
26.80	1192.54	1192.96	1193.39	1193.81	1194.24	1194.66	1195.09	1195.51	1195.94	1196.36	1196.79	26.80
26.90	1196.79	1197.21	1197.64	1198.07	1198.49	1198.92	1199.34	1199.77	1200.19	1200.62	1201.05	26.90
27.00	1201.05	1201.47	1201.90	1202.32	1202.75	1203.17	1203.60	1204.02	1204.45	1204.88	1205.30	27.00
27.10	1205.30	1205.73	1206.15	1206.58	1207.01	1207.43	1207.86	1208.28	1208.71	1209.13	1209.56	27.10
27.20	1209.56	1209.99	1210.41	1210.84	1211.26	1211.69	1212.12	1212.54	1212.97	1213.39	1213.82	27.20
27.30	1213.82	1214.25	1214.67	1215.10	1215.53	1215.95	1216.38	1216.80	1217.23	1217.66	1218.08	27.30
27.40	1218.08	1218.51	1218.93	1219.36	1219.79	1220.21	1220.64	1221.07	1221.49	1221.92	1222.35	27.40
27.50	1222.35	1222.77	1223.20	1223.62	1224.05	1224.48	1224.90	1225.33	1225.76	1226.18	1226.61	27.50
27.60	1226.61	1227.04	1227.46	1227.89	1228.32	1228.74	1229.17	1229.60	1230.02	1230.45	1230.88	27.60
27.70	1230.88	1231.30	1231.73	1232.16	1232.58	1233.01	1233.44	1233.86	1234.29	1234.72	1235.14	27.70
27.80	1235.14	1235.57	1236.00	1236.42	1236.85	1237.28	1237.71	1238.13	1238.56	1238.99	1239.41	27.80
27.90	1239.41	1239.84	1240.27	1240.69	1241.12	1241.55	1241.98	1242.40	1242.83	1243.26	1243.68	27.90
28.00	1243.68	1244.11	1244.54	1244.97	1245.39	1245.82	1246.25	1246.68	1247.10	1247.53	1247.96	28.00
28.10	1247.96	1248.39	1248.81	1249.24	1249.67	1250.09	1250.52	1250.95	1251.38	1251.80	1252.23	28.10
28.20	1252.23	1252.66	1253.09	1253.52	1253.94	1254.37	1254.80	1255.23	1255.65	1256.08	1256.51	28.20
28.30	1256.51	1256.94	1257.36	1257.79	1258.22	1258.65	1259.08	1259.50	1259.93	1260.36	1260.79	28.30
28.40	1260.79	1261.21	1261.64	1262.07	1262.50	1262.93	1263.35	1263.78	1264.21	1264.64	1265.07	28.40
28.50	1265.07	1265.49	1265.92	1266.35	1266.78	1267.21	1267.64	1268.06	1268.49	1268.92	1269.35	28.50
28.60	1269.35	1269.78	1270.20	1270.63	1271.06	1271.49	1271.92	1272.35	1272.77	1273.20	1273.63	28.60
28.70	1273.63	1274.06	1274.49	1274.92	1275.35	1275.77	1276.20	1276.63	1277.06	1277.49	1277.92	28.70
28.80	1277.92	1278.35	1278.77	1279.20	1279.63	1280.06	1280.49	1280.92	1281.35	1281.78	1282.20	28.80
28.90	1282.20	1282.63	1283.06	1283.49	1283.92	1284.35	1284.78	1285.21	1285.64	1286.06	1286.49	28.90
29.00	1286.49	1286.92	1287.35	1287.78	1288.21	1288.64	1289.07	1289.50	1289.93	1290.36	1290.78	29.00
29.10	1290.78	1291.21	1291.64	1292.07	1292.50	1292.93	1293.36	1293.79	1294.22	1294.65	1295.08	29.10
29.20	1295.08	1295.51	1295.94	1296.37	1296.80	1297.22	1297.65	1298.08	1298.51	1298.94	1299.37	29.20
29.30	1299.37	1299.80	1300.23	1300.66	1301.09	1301.52	1301.95	1302.38	1302.81	1303.24	1303.67	29.30
29.40	1303.67	1304.10	1304.53	1304.96	1305.39	1305.82	1306.25	1306.68	1307.11	1307.54	1307.97	29.40
29.50	1307.97	1308.40	1308.83	1309.26	1309.69	1310.12	1310.55	1310.98	1311.41	1311.84	1312.27	29.50
29.60	1312.27	1312.70	1313.13	1313.56	1313.99	1314.42	1314.85	1315.28	1315.71	1316.14	1316.57	29.60
29.70	1316.57	1317.00	1317.43	1317.86	1318.29	1318.72	1319.16	1319.59	1320.02	1320.45	1320.88	29.70
29.80	1320.88	1321.31	1321.74	1322.17	1322.60	1323.03	1323.46	1323.89	1324.32	1324.75	1325.19	29.80
29.90	1325.19	1325.62	1326.05	1326.48	1326.91	1327.34	1327.77	1328.20	1328.63	1329.06	1329.49	29.90
30.00	1329.49	1329.93	1330.36	1330.79	1331.22	1331.65	1332.08	1332.51	1332.94	1333.38	1333.81	30.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
30.00	1329.49	1329.93	1330.36	1330.79	1331.22	1331.65	1332.08	1332.51	1332.94	1333.38	1333.81	30.00
30.10	1333.81	1334.24	1334.67	1335.10	1335.53	1335.96	1336.39	1336.83	1337.26	1337.69	1338.12	30.10
30.20	1338.12	1338.55	1338.98	1339.41	1339.85	1340.28	1340.71	1341.14	1341.57	1342.00	1342.44	30.20
30.30	1342.44	1342.87	1343.30	1343.73	1344.16	1344.59	1345.03	1345.46	1345.89	1346.32	1346.75	30.30
30.40	1346.75	1347.19	1347.62	1348.05	1348.48	1348.91	1349.35	1349.78	1350.21	1350.64	1351.07	30.40
30.50	1351.07	1351.51	1351.94	1352.37	1352.80	1353.24	1353.67	1354.10	1354.53	1354.96	1355.40	30.50
30.60	1355.40	1355.83	1356.26	1356.69	1357.13	1357.56	1357.99	1358.42	1358.86	1359.29	1359.72	30.60
30.70	1359.72	1360.15	1360.59	1361.02	1361.45	1361.89	1362.32	1362.75	1363.18	1363.62	1364.05	30.70
30.80	1364.05	1364.48	1364.91	1365.35	1365.78	1366.21	1366.65	1367.08	1367.51	1367.95	1368.38	30.80
30.90	1368.38	1368.81	1369.24	1369.68	1370.11	1370.54	1370.98	1371.41	1371.84	1372.28	1372.71	30.90
31.00	1372.71	1373.14	1373.58	1374.01	1374.44	1374.88	1375.31	1375.74	1376.18	1376.61	1377.04	31.00
31.10	1377.04	1377.48	1377.91	1378.35	1378.78	1379.21	1379.65	1380.08	1380.51	1380.95	1381.38	31.10
31.20	1381.38	1381.81	1382.25	1382.68	1383.12	1383.55	1383.98	1384.42	1384.85	1385.29	1385.72	31.20
31.30	1385.72	1386.15	1386.59	1387.02	1387.46	1387.89	1388.32	1388.76	1389.19	1389.63	1390.06	31.30
31.40	1390.06	1390.50	1390.93	1391.36	1391.80	1392.23	1392.67	1393.10	1393.54	1393.97	1394.40	31.40
31.50	1394.40	1394.84	1395.27	1395.71	1396.14	1396.58	1397.01	1397.45	1397.88	1398.32	1398.75	31.50
31.60	1398.75	1399.19	1399.62	1400.06	1400.49	1400.92	1401.36	1401.79	1402.23	1402.66	1403.10	31.60
31.70	1403.10	1403.53	1403.97	1404.40	1404.84	1405.27	1405.71	1406.14	1406.58	1407.02	1407.45	31.70
31.80	1407.45	1407.89	1408.32	1408.76	1409.19	1409.63	1410.06	1410.50	1410.93	1411.37	1411.80	31.80
31.90	1411.80	1412.24	1412.67	1413.11	1413.55	1413.98	1414.42	1414.85	1415.29	1415.72	1416.16	31.90
32.00	1416.16	1416.60	1417.03	1417.47	1417.90	1418.34	1418.77	1419.21	1419.65	1420.08	1420.52	32.00
32.10	1420.52	1420.95	1421.39	1421.83	1422.26	1422.70	1423.13	1423.57	1424.01	1424.44	1424.88	32.10
32.20	1424.88	1425.32	1425.75	1426.19	1426.62	1427.06	1427.50	1427.93	1428.37	1428.81	1429.24	32.20
32.30	1429.24	1429.68	1430.12	1430.55	1430.99	1431.43	1431.86	1432.30	1432.74	1433.17	1433.61	32.30
32.40	1433.61	1434.05	1434.48	1434.92	1435.36	1435.79	1436.23	1436.67	1437.10	1437.54	1437.98	32.40
32.50	1437.98	1438.41	1438.85	1439.29	1439.73	1440.16	1440.60	1441.04	1441.47	1441.91	1442.35	32.50
32.60	1442.35	1442.79	1443.22	1443.66	1444.10	1444.53	1444.97	1445.41	1445.85	1446.28	1446.72	32.60
32.70	1446.72	1447.16	1447.60	1448.03	1448.47	1448.91	1449.35	1449.79	1450.22	1450.66	1451.10	32.70
32.80	1451.10	1451.54	1451.97	1452.41	1452.85	1453.29	1453.73	1454.16	1454.60	1455.04	1455.48	32.80
32.90	1455.48	1455.92	1456.35	1456.79	1457.23	1457.67	1458.11	1458.54	1458.98	1459.42	1459.86	32.90
33.00	1459.86	1460.30	1460.74	1461.17	1461.61	1462.05	1462.49	1462.93	1463.37	1463.80	1464.24	33.00
33.10	1464.24	1464.68	1465.12	1465.56	1466.00	1466.44	1466.88	1467.31	1467.75	1468.19	1468.63	33.10
33.20	1468.63	1469.07	1469.51	1469.95	1470.39	1470.82	1471.26	1471.70	1472.14	1472.58	1473.02	33.20
33.30	1473.02	1473.46	1473.90	1474.34	1474.78	1475.22	1475.65	1476.09	1476.53	1476.97	1477.41	33.30
33.40	1477.41	1477.85	1478.29	1478.73	1479.17	1479.61	1480.05	1480.49	1480.93	1481.37	1481.81	33.40
33.50	1481.81	1482.25	1482.69	1483.13	1483.57	1484.01	1484.45	1484.88	1485.32	1485.76	1486.20	33.50
33.60	1486.20	1486.64	1487.08	1487.52	1487.96	1488.40	1488.84	1489.28	1489.72	1490.16	1490.60	33.60
33.70	1490.60	1491.04	1491.49	1491.93	1492.37	1492.81	1493.25	1493.69	1494.13	1494.57	1495.01	33.70
33.80	1495.01	1495.45	1495.89	1496.33	1496.77	1497.21	1497.65	1498.09	1498.53	1498.97	1499.41	33.80
33.90	1499.41	1499.85	1500.30	1500.74	1501.18	1501.62	1502.06	1502.50	1502.94	1503.38	1503.82	33.90
34.00	1503.82	1504.26	1504.70	1505.15	1505.59	1506.03	1506.47	1506.91	1507.35	1507.79	1508.23	34.00
34.10	1508.23	1508.67	1509.12	1509.56	1510.00	1510.44	1510.88	1511.32	1511.76	1512.21	1512.65	34.10
34.20	1512.65	1513.09	1513.53	1513.97	1514.41	1514.86	1515.30	1515.74	1516.18	1516.62	1517.06	34.20
34.30	1517.06	1517.51	1517.95	1518.39	1518.83	1519.27	1519.72	1520.16	1520.60	1521.04	1521.48	34.30
34.40	1521.48	1521.93	1522.37	1522.81	1523.25	1523.69	1524.14	1524.58	1525.02	1525.46	1525.91	34.40
34.50	1525.91	1526.35	1526.79	1527.23	1527.68	1528.12	1528.56	1529.00	1529.45	1529.89	1530.33	34.50
34.60	1530.33	1530.77	1531.22	1531.66	1532.10	1532.54	1532.99	1533.43	1533.87	1534.32	1534.76	34.60
34.70	1534.76	1535.20	1535.64	1536.09	1536.53	1536.97	1537.42	1537.86	1538.30	1538.75	1539.19	34.70
34.80	1539.19	1539.63	1540.08	1540.52	1540.96	1541.41	1541.85	1542.29	1542.74	1543.18	1543.62	34.80
34.90	1543.62	1544.07	1544.51	1544.95	1545.40	1545.84	1546.28	1546.73	1547.17	1547.62	1548.06	34.90
35.00	1548.06	1548.50	1548.95	1549.39	1549.83	1550.28	1550.72	1551.17	1551.61	1552.05	1552.50	35.00
35.10	1552.50	1552.94	1553.39	1553.83	1554.27	1554.72	1555.16	1555.61	1556.05	1556.50	1556.94	35.10
35.20	1556.94	1557.38	1557.83	1558.27	1558.72	1559.16	1559.61	1560.05	1560.50	1560.94	1561.39	35.20
35.30	1561.39	1561.83	1562.27	1562.72	1563.16	1563.61	1564.05	1564.50	1564.94	1565.39	1565.83	35.30
35.40	1565.83	1566.28	1566.72	1567.17	1567.61	1568.06	1568.50	1568.95	1569.39	1569.84	1570.28	35.40
35.50	1570.28	1570.73	1571.17	1571.62	1572.06	1572.51	1572.96	1573.40	1573.85	1574.29	1574.74	35.50
35.60	1574.74	1575.18	1575.63	1576.07	1576.52	1576.96	1577.41	1577.86	1578.30	1578.75	1579.19	35.60
35.70	1579.19	1579.64	1580.08	1580.53	1580.98	1581.42	1581.87	1582.31	1582.76	1583.21	1583.65	35.70
35.80	1583.65	1584.10	1584.54	1584.99	1585.44	1585.88	1586.33	1586.78	1587.22	1587.67	1588.11	35.80
35.90	1588.11	1588.56	1589.01	1589.45	1589.90	1590.35	1590.79	1591.24	1591.69	1592.13	1592.58	35.90
36.00	1592.58	1593.03	1593.47	1593.92	1594.37	1594.81	1595.26	1595.71	1596.15	1596.60	1597.05	36.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. *Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
36.00	1592.58	1593.03	1593.47	1593.92	1594.37	1594.81	1595.26	1595.71	1596.15	1596.60	1597.05	36.00
36.10	1597.05	1597.49	1597.94	1598.39	1598.83	1599.28	1599.73	1600.18	1600.62	1601.07	1601.52	36.10
36.20	1601.52	1601.96	1602.41	1602.86	1603.31	1603.75	1604.20	1604.65	1605.10	1605.54	1605.99	36.20
36.30	1605.99	1606.44	1606.89	1607.33	1607.78	1608.23	1608.68	1609.12	1609.57	1610.02	1610.47	36.30
36.40	1610.47	1610.92	1611.36	1611.81	1612.26	1612.71	1613.15	1613.60	1614.05	1614.50	1614.95	36.40
36.50	1614.95	1615.39	1615.84	1616.29	1616.74	1617.19	1617.64	1618.08	1618.53	1618.98	1619.43	36.50
36.60	1619.43	1619.88	1620.33	1620.77	1621.22	1621.67	1622.12	1622.57	1623.02	1623.47	1623.91	36.60
36.70	1623.91	1624.36	1624.81	1625.26	1625.71	1626.16	1626.61	1627.06	1627.50	1627.95	1628.40	36.70
36.80	1628.40	1628.85	1629.30	1629.75	1630.20	1630.65	1631.10	1631.55	1631.99	1632.44	1632.89	36.80
36.90	1632.89	1633.34	1633.79	1634.24	1634.69	1635.14	1635.59	1636.04	1636.49	1636.94	1637.39	36.90
37.00	1637.39	1637.84	1638.29	1638.74	1639.19	1639.64	1640.08	1640.53	1640.98	1641.43	1641.88	37.00
37.10	1641.88	1642.33	1642.78	1643.23	1643.68	1644.13	1644.58	1645.03	1645.48	1645.93	1646.38	37.10
37.20	1646.38	1646.83	1647.28	1647.73	1648.18	1648.63	1649.09	1649.54	1649.99	1650.44	1650.89	37.20
37.30	1650.89	1651.34	1651.79	1652.24	1652.69	1653.14	1653.59	1654.04	1654.49	1654.94	1655.39	37.30
37.40	1655.39	1655.84	1656.29	1656.74	1657.20	1657.65	1658.10	1658.55	1659.00	1659.45	1659.90	37.40
37.50	1659.90	1660.35	1660.80	1661.25	1661.71	1662.16	1662.61	1663.06	1663.51	1663.96	1664.41	37.50
37.60	1664.41	1664.86	1665.32	1665.77	1666.22	1666.67	1667.12	1667.57	1668.02	1668.48	1668.93	37.60
37.70	1668.93	1669.38	1669.83	1670.28	1670.73	1671.19	1671.64	1672.09	1672.54	1672.99	1673.44	37.70
37.80	1673.44	1673.90	1674.35	1674.80	1675.25	1675.70	1676.16	1676.61	1677.06	1677.51	1677.96	37.80
37.90	1677.96	1678.42	1678.87	1679.32	1679.77	1680.23	1680.68	1681.13	1681.58	1682.04	1682.49	37.90
38.00	1682.49	1682.94	1683.39	1683.85	1684.30	1684.75	1685.20	1685.66	1686.11	1686.56	1687.01	38.00
38.10	1687.01	1687.47	1687.92	1688.37	1688.83	1689.28	1689.73	1690.18	1690.64	1691.09	1691.54	38.10
38.20	1691.54	1692.00	1692.45	1692.90	1693.36	1693.81	1694.26	1694.72	1695.17	1695.62	1696.08	38.20
38.30	1696.08	1696.53	1696.98	1697.44	1697.89	1698.34	1698.80	1699.25	1699.70	1700.16	1700.61	38.30
38.40	1700.61	1701.07	1701.52	1701.97	1702.43	1702.88	1703.33	1703.79	1704.24	1704.70	1705.15	38.40
38.50	1705.15	1705.60	1706.06	1706.51	1706.97	1707.42	1707.87	1708.33	1708.78	1709.24	1709.69	38.50
38.60	1709.69	1710.15	1710.60	1711.05	1711.51	1711.96	1712.42	1712.87	1713.33	1713.78	1714.24	38.60
38.70	1714.24	1714.69	1715.14	1715.60	1716.05	1716.51	1716.96	1717.42	1717.87	1718.33	1718.78	38.70
38.80	1718.78	1719.24	1719.69	1720.15	1720.60	1721.06	1721.51	1721.97	1722.42	1722.88	1723.33	38.80
38.90	1723.33	1723.79	1724.24	1724.70	1725.15	1725.61	1726.06	1726.52	1726.97	1727.43	1727.89	38.90
39.00	1727.89	1728.34	1728.80	1729.25	1729.71	1730.16	1730.62	1731.07	1731.53	1731.99	1732.44	39.00
39.10	1732.44	1732.90	1733.35	1733.81	1734.27	1734.72	1735.18	1735.63	1736.09	1736.55	1737.00	39.10
39.20	1737.00	1737.46	1737.91	1738.37	1738.83	1739.28	1739.74	1740.19	1740.65	1741.11	1741.56	39.20
39.30	1741.56	1742.02	1742.48	1742.93	1743.39	1743.85	1744.30	1744.76	1745.22	1745.67	1746.13	39.30
39.40	1746.13	1746.59	1747.04	1747.50	1747.96	1748.41	1748.87	1749.33	1749.78	1750.24	1750.70	39.40
39.50	1750.70	1751.15	1751.61	1752.07	1752.52	1752.98	1753.44	1753.90	1754.35	1754.81	1755.27	39.50
39.60	1755.27	1755.73	1756.18	1756.64	1757.10	1757.55	1758.01	1758.47	1758.93	1759.38	1759.84	39.60
39.70	1759.84	1760.30	1760.76	1761.22	1761.67	1762.13	1762.59	1763.05	1763.50	1763.96	1764.42	39.70
39.80	1764.42	1764.88	1765.34	1765.79	1766.25	1766.71	1767.17	1767.63	1768.08	1768.54	1769.00	39.80
39.90	1769.00	1769.46	1769.92	1770.37	1770.83	1771.29	1771.75	1772.21	1772.67	1773.12	1773.58	39.90
40.00	1773.58	1774.04	1774.50	1774.96	1775.42	1775.88	1776.33	1776.79	1777.25	1777.71	1778.17	40.00
40.10	1778.17	1778.63	1779.09	1779.55	1780.01	1780.46	1780.92	1781.38	1781.84	1782.30	1782.76	40.10
40.20	1782.76	1783.22	1783.68	1784.14	1784.60	1785.06	1785.51	1785.97	1786.43	1786.89	1787.35	40.20
40.30	1787.35	1787.81	1788.27	1788.73	1789.19	1789.65	1790.11	1790.57	1791.03	1791.49	1791.95	40.30
40.40	1791.95	1792.41	1792.87	1793.33	1793.79	1794.25	1794.71	1795.17	1795.63	1796.09	1796.55	40.40
40.50	1796.55	1797.01	1797.47	1797.93	1798.39	1798.85	1799.31	1799.77	1800.23	1800.69	1801.15	40.50
40.60	1801.15	1801.61	1802.07	1802.53	1802.99	1803.45	1803.91	1804.37	1804.83	1805.29	1805.75	40.60
40.70	1805.75	1806.21	1806.67	1807.13	1807.60	1808.06	1808.52	1808.98	1809.44	1809.90	1810.36	40.70
40.80	1810.36	1810.82	1811.28	1811.74	1812.20	1812.67	1813.13	1813.59	1814.05	1814.51	1814.97	40.80
40.90	1814.97	1815.43	1815.89	1816.36	1816.82	1817.28	1817.74	1818.20	1818.66	1819.12	1819.59	40.90
41.00	1819.59	1820.05	1820.51	1820.97	1821.43	1821.89	1822.36	1822.82	1823.28	1823.74	1824.20	41.00
41.10	1824.20	1824.66	1825.13	1825.59	1826.05	1826.51	1826.97	1827.44	1827.90	1828.36	1828.82	41.10
41.20	1828.82	1829.29	1829.75	1830.21	1830.67	1831.13	1831.60	1832.06	1832.52	1832.98	1833.45	41.20
41.30	1833.45	1833.91	1834.37	1834.83	1835.30	1835.76	1836.22	1836.69	1837.15	1837.61	1838.07	41.30
41.40	1838.07	1838.54	1839.00	1839.46	1839.93	1840.39	1840.85	1841.31	1841.78	1842.24	1842.70	41.40
41.50	1842.70	1843.17	1843.63	1844.09	1844.56	1845.02	1845.48	1845.95	1846.41	1846.87	1847.34	41.50
41.60	1847.34	1847.80	1848.26	1848.73	1849.19	1849.65	1850.12	1850.58	1851.05	1851.51	1851.97	41.60
41.70	1851.97	1852.44	1852.90	1853.36	1853.83	1854.29	1854.76	1855.22	1855.68	1856.15	1856.61	41.70
41.80	1856.61	1857.08	1857.54	1858.00	1858.47	1858.93	1859.40	1859.86	1860.33	1860.79	1861.25	41.80
41.90	1861.25	1861.72	1862.18	1862.65	1863.11	1863.58	1864.04	1864.51	1864.97	1865.44	1865.90	41.90
42.00	1865.90	1866.37	1866.83	1867.29	1867.76	1868.22	1868.69	1869.15	1869.62	1870.08	1870.55	42.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. *Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
42.00	1865.90	1866.37	1866.83	1867.29	1867.76	1868.22	1868.69	1869.15	1869.62	1870.08	1870.55	42.00
42.10	1870.55	1871.01	1871.48	1871.94	1872.41	1872.88	1873.34	1873.81	1874.27	1874.74	1875.20	42.10
42.20	1875.20	1875.67	1876.13	1876.60	1877.06	1877.53	1877.99	1878.46	1878.93	1879.39	1879.86	42.20
42.30	1879.86	1880.32	1880.79	1881.25	1881.72	1882.19	1882.65	1883.12	1883.58	1884.05	1884.52	42.30
42.40	1884.52	1884.98	1885.45	1885.91	1886.38	1886.85	1887.31	1887.78	1888.25	1888.71	1889.18	42.40
42.50	1889.18	1889.64	1890.11	1890.58	1891.04	1891.51	1891.98	1892.44	1892.91	1893.38	1893.84	42.50
42.60	1893.84	1894.31	1894.78	1895.24	1895.71	1896.18	1896.64	1897.11	1897.58	1898.05	1898.51	42.60
42.70	1898.51	1898.98	1899.45	1899.91	1900.38	1900.85	1901.31	1901.78	1902.25	1902.72	1903.18	42.70
42.80	1903.18	1903.65	1904.12	1904.59	1905.05	1905.52	1905.99	1906.46	1906.92	1907.39	1907.86	42.80
42.90	1907.86	1908.33	1908.79	1909.26	1909.73	1910.20	1910.67	1911.13	1911.60	1912.07	1912.54	42.90
43.00	1912.54	1913.01	1913.47	1913.94	1914.41	1914.88	1915.35	1915.82	1916.28	1916.75	1917.22	43.00
43.10	1917.22	1917.69	1918.16	1918.63	1919.09	1919.56	1920.03	1920.50	1920.97	1921.44	1921.91	43.10
43.20	1921.91	1922.37	1922.84	1923.31	1923.78	1924.25	1924.72	1925.19	1925.66	1926.13	1926.59	43.20
43.30	1926.59	1927.06	1927.53	1928.00	1928.47	1928.94	1929.41	1929.88	1930.35	1930.82	1931.29	43.30
43.40	1931.29	1931.76	1932.23	1932.70	1933.16	1933.63	1934.10	1934.57	1935.04	1935.51	1935.98	43.40
43.50	1935.98	1936.45	1936.92	1937.39	1937.86	1938.33	1938.80	1939.27	1939.74	1940.21	1940.68	43.50
43.60	1940.68	1941.15	1941.62	1942.09	1942.56	1943.03	1943.50	1943.97	1944.44	1944.91	1945.38	43.60
43.70	1945.38	1945.86	1946.33	1946.80	1947.27	1947.74	1948.21	1948.68	1949.15	1949.62	1950.09	43.70
43.80	1950.09	1950.56	1951.03	1951.50	1951.97	1952.45	1952.92	1953.39	1953.86	1954.33	1954.80	43.80
43.90	1954.80	1955.27	1955.74	1956.21	1956.69	1957.16	1957.63	1958.10	1958.57	1959.04	1959.51	43.90
44.00	1959.51	1959.99	1960.46	1960.93	1961.40	1961.87	1962.34	1962.82	1963.29	1963.76	1964.23	44.00
44.10	1964.23	1964.70	1965.18	1965.65	1966.12	1966.59	1967.06	1967.54	1968.01	1968.48	1968.95	44.10
44.20	1968.95	1969.42	1969.90	1970.37	1970.84	1971.31	1971.79	1972.26	1972.73	1973.20	1973.68	44.20
44.30	1973.68	1974.15	1974.62	1975.09	1975.57	1976.04	1976.51	1976.99	1977.46	1977.93	1978.40	44.30
44.40	1978.40	1978.88	1979.35	1979.82	1980.30	1980.77	1981.24	1981.72	1982.19	1982.66	1983.14	44.40
44.50	1983.14	1983.61	1984.08	1984.56	1985.03	1985.50	1985.98	1986.45	1986.92	1987.40	1987.87	44.50
44.60	1987.87	1988.35	1988.82	1989.29	1989.77	1990.24	1990.72	1991.19	1991.66	1992.14	1992.61	44.60
44.70	1992.61	1993.09	1993.56	1994.03	1994.51	1994.98	1995.46	1995.93	1996.41	1996.88	1997.35	44.70
44.80	1997.35	1997.83	1998.30	1998.78	1999.25	1999.73	2000.20	2000.68	2001.15	2001.63	2002.10	44.80
44.90	2002.10	2002.58	2003.05	2003.53	2004.00	2004.48	2004.95	2005.43	2005.90	2006.38	2006.85	44.90
45.00	2006.85	2007.33	2007.80	2008.28	2008.75	2009.23	2009.70	2010.18	2010.66	2011.13	2011.61	45.00
45.10	2011.61	2012.08	2012.56	2013.03	2013.51	2013.99	2014.46	2014.94	2015.41	2015.89	2016.37	45.10
45.20	2016.37	2016.84	2017.32	2017.79	2018.27	2018.75	2019.22	2019.70	2020.17	2020.65	2021.13	45.20
45.30	2021.13	2021.60	2022.08	2022.56	2023.03	2023.51	2023.99	2024.46	2024.94	2025.42	2025.89	45.30
45.40	2025.89	2026.37	2026.85	2027.32	2027.80	2028.28	2028.76	2029.23	2029.71	2030.19	2030.66	45.40
45.50	2030.66	2031.14	2031.62	2032.10	2032.57	2033.05	2033.53	2034.01	2034.48	2034.96	2035.44	45.50
45.60	2035.44	2035.92	2036.39	2036.87	2037.35	2037.83	2038.31	2038.78	2039.26	2039.74	2040.22	45.60
45.70	2040.22	2040.70	2041.17	2041.65	2042.13	2042.61	2043.09	2043.57	2044.04	2044.52	2045.00	45.70
45.80	2045.00	2045.48	2045.96	2046.44	2046.92	2047.39	2047.87	2048.35	2048.83	2049.31	2049.79	45.80
45.90	2049.79	2050.27	2050.75	2051.22	2051.70	2052.18	2052.66	2053.14	2053.62	2054.10	2054.58	45.90
46.00	2054.58	2055.06	2055.54	2056.02	2056.50	2056.98	2057.46	2057.94	2058.41	2058.89	2059.37	46.00
46.10	2059.37	2059.85	2060.33	2060.81	2061.29	2061.77	2062.25	2062.73	2063.21	2063.69	2064.17	46.10
46.20	2064.17	2064.65	2065.13	2065.61	2066.10	2066.58	2067.06	2067.54	2068.02	2068.50	2068.98	46.20
46.30	2068.98	2069.46	2069.94	2070.42	2070.90	2071.38	2071.86	2072.34	2072.82	2073.31	2073.79	46.30
46.40	2073.79	2074.27	2074.75	2075.23	2075.71	2076.19	2076.67	2077.15	2077.64	2078.12	2078.60	46.40
46.50	2078.60	2079.08	2079.56	2080.04	2080.53	2081.01	2081.49	2081.97	2082.45	2082.93	2083.42	46.50
46.60	2083.42	2083.90	2084.38	2084.86	2085.34	2085.83	2086.31	2086.79	2087.27	2087.76	2088.24	46.60
46.70	2088.24	2088.72	2089.20	2089.69	2090.17	2090.65	2091.13	2091.62	2092.10	2092.58	2093.06	46.70
46.80	2093.06	2093.55	2094.03	2094.51	2095.00	2095.48	2095.96	2096.45	2096.93	2097.41	2097.90	46.80
46.90	2097.90	2098.38	2098.86	2099.35	2099.83	2100.31	2100.80	2101.28	2101.76	2102.25	2102.73	46.90
47.00	2102.73	2103.21	2103.70	2104.18	2104.67	2105.15	2105.63	2106.12	2106.60	2107.09	2107.57	47.00
47.10	2107.57	2108.06	2108.54	2109.02	2109.51	2109.99	2110.48	2110.96	2111.45	2111.93	2112.42	47.10
47.20	2112.42	2112.90	2113.39	2113.87	2114.36	2114.84	2115.33	2115.81	2116.30	2116.78	2117.27	47.20
47.30	2117.27	2117.75	2118.24	2118.72	2119.21	2119.69	2120.18	2120.66	2121.15	2121.63	2122.12	47.30
47.40	2122.12	2122.61	2123.09	2123.58	2124.06	2124.55	2125.04	2125.52	2126.01	2126.49	2126.98	47.40
47.50	2126.98	2127.47	2127.95	2128.44	2128.92	2129.41	2129.90	2130.38	2130.87	2131.36	2131.84	47.50
47.60	2131.84	2132.33	2132.82	2133.30	2133.79	2134.28	2134.76	2135.25	2135.74	2136.23	2136.71	47.60
47.70	2136.71	2137.20	2137.69	2138.18	2138.66	2139.15	2139.64	2140.12	2140.61	2141.10	2141.59	47.70
47.80	2141.59	2142.08	2142.56	2143.05	2143.54	2144.03	2144.51	2145.00	2145.49	2145.98	2146.47	47.80
47.90	2146.47	2146.96	2147.44	2147.93	2148.42	2148.91	2149.40	2149.89	2150.37	2150.86	2151.35	47.90
48.00	2151.35	2151.84	2152.33	2152.82	2153.31	2153.80	2154.28	2154.77	2155.26	2155.75	2156.24	48.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. *Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
48.00	2151.35	2151.84	2152.33	2152.82	2153.31	2153.80	2154.28	2154.77	2155.26	2155.75	2156.24	48.00
48.10	2156.24	2156.73	2157.22	2157.71	2158.20	2158.69	2159.18	2159.67	2160.16	2160.65	2161.14	48.10
48.20	2161.14	2161.63	2162.12	2162.61	2163.10	2163.59	2164.08	2164.57	2165.06	2165.55	2166.04	48.20
48.30	2166.04	2166.53	2167.02	2167.51	2168.00	2168.49	2168.98	2169.47	2169.96	2170.45	2170.94	48.30
48.40	2170.94	2171.43	2171.92	2172.41	2172.91	2173.40	2173.89	2174.38	2174.87	2175.36	2175.85	48.40
48.50	2175.85	2176.34	2176.84	2177.33	2177.82	2178.31	2178.80	2179.29	2179.78	2180.28	2180.77	48.50
48.60	2180.77	2181.26	2181.75	2182.24	2182.74	2183.23	2183.72	2184.21	2184.71	2185.20	2185.69	48.60
48.70	2185.69	2186.18	2186.68	2187.17	2187.66	2188.15	2188.65	2189.14	2189.63	2190.12	2190.62	48.70
48.80	2190.62	2191.11	2191.60	2192.10	2192.59	2193.08	2193.58	2194.07	2194.56	2195.06	2195.55	48.80
48.90	2195.55	2196.04	2196.54	2197.03	2197.53	2198.02	2198.51	2199.01	2199.50	2199.99	2200.49	48.90
49.00	2200.49	2200.98	2201.48	2201.97	2202.47	2202.96	2203.45	2203.95	2204.44	2204.94	2205.43	49.00
49.10	2205.43	2205.93	2206.42	2206.92	2207.41	2207.91	2208.40	2208.90	2209.39	2209.89	2210.38	49.10
49.20	2210.38	2210.88	2211.37	2211.87	2212.36	2212.86	2213.36	2213.85	2214.35	2214.84	2215.34	49.20
49.30	2215.34	2215.83	2216.33	2216.83	2217.32	2217.82	2218.31	2218.81	2219.31	2219.80	2220.30	49.30
49.40	2220.30	2220.80	2221.29	2221.79	2222.29	2222.78	2223.28	2223.78	2224.27	2224.77	2225.27	49.40
49.50	2225.27	2225.76	2226.26	2226.76	2227.26	2227.75	2228.25	2228.75	2229.25	2229.74	2230.24	49.50
49.60	2230.24	2230.74	2231.24	2231.73	2232.23	2232.73	2233.23	2233.73	2234.22	2234.72	2235.22	49.60
49.70	2235.22	2235.72	2236.22	2236.72	2237.21	2237.71	2238.21	2238.71	2239.21	2239.71	2240.21	49.70
49.80	2240.21	2240.70	2241.20	2241.70	2242.20	2242.70	2243.20	2243.70	2244.20	2244.70	2245.20	49.80
49.90	2245.20	2245.70	2246.20	2246.70	2247.20	2247.70	2248.20	2248.70	2249.20	2249.70	2250.20	49.90
50.00	2250.20	2250.70	2251.20	2251.70	2252.20	2252.70	2253.20	2253.70	2254.20	2254.70	2255.20	50.00
50.10	2255.20	2255.70	2256.20	2256.70	2257.20	2257.70	2258.20	2258.71	2259.21	2259.71	2260.21	50.10
50.20	2260.21	2260.71	2261.21	2261.71	2262.21	2262.72	2263.22	2263.72	2264.22	2264.72	2265.23	50.20
50.30	2265.23	2265.73	2266.23	2266.73	2267.23	2267.74	2268.24	2268.74	2269.24	2269.75	2270.25	50.30
50.40	2270.25	2270.75	2271.25	2271.76	2272.26	2272.76	2273.26	2273.77	2274.27	2274.77	2275.28	50.40
50.50	2275.28	2275.78	2276.28	2276.79	2277.29	2277.79	2278.30	2278.80	2279.31	2279.81	2280.31	50.50
50.60	2280.31	2280.82	2281.32	2281.82	2282.33	2282.83	2283.34	2283.84	2284.35	2284.85	2285.35	50.60
50.70	2285.35	2285.86	2286.36	2286.87	2287.37	2287.88	2288.38	2288.89	2289.39	2289.90	2290.40	50.70
50.80	2290.40	2290.91	2291.41	2291.92	2292.42	2292.93	2293.44	2293.94	2294.45	2294.95	2295.46	50.80
50.90	2295.46	2295.96	2296.47	2296.98	2297.48	2297.99	2298.49	2299.00	2299.51	2300.01	2300.52	50.90
51.00	2300.52	2301.03	2301.53	2302.04	2302.55	2303.05	2303.56	2304.07	2304.57	2305.08	2305.59	51.00
51.10	2305.59	2306.09	2306.60	2307.11	2307.62	2308.12	2308.63	2309.14	2309.65	2310.15	2310.66	51.10
51.20	2310.66	2311.17	2311.68	2312.19	2312.69	2313.20	2313.71	2314.22	2314.73	2315.23	2315.74	51.20
51.30	2315.74	2316.25	2316.76	2317.27	2317.78	2318.29	2318.80	2319.30	2319.81	2320.32	2320.83	51.30
51.40	2320.83	2321.34	2321.85	2322.36	2322.87	2323.38	2323.89	2324.40	2324.91	2325.42	2325.93	51.40
51.50	2325.93	2326.44	2326.95	2327.46	2327.97	2328.48	2328.99	2329.50	2330.01	2330.52	2331.03	51.50
51.60	2331.03	2331.54	2332.05	2332.56	2333.07	2333.58	2334.09	2334.60	2335.11	2335.62	2336.13	51.60
51.70	2336.13	2336.65	2337.16	2337.67	2338.18	2338.69	2339.20	2339.71	2340.23	2340.74	2341.25	51.70
51.80	2341.25	2341.76	2342.27	2342.79	2343.30	2343.81	2344.32	2344.83	2345.35	2345.86	2346.37	51.80
51.90	2346.37	2346.88	2347.40	2347.91	2348.42	2348.93	2349.45	2349.96	2350.47	2350.99	2351.50	51.90
52.00	2351.50	2352.01	2352.53	2353.04	2353.55	2354.07	2354.58	2355.09	2355.61	2356.12	2356.63	52.00
52.10	2356.63	2357.15	2357.66	2358.18	2358.69	2359.20	2359.72	2360.23	2360.75	2361.26	2361.78	52.10
52.20	2361.78	2362.29	2362.80	2363.32	2363.83	2364.35	2364.86	2365.38	2365.89	2366.41	2366.92	52.20
52.30	2366.92	2367.44	2367.95	2368.47	2368.98	2369.50	2370.02	2370.53	2371.05	2371.56	2372.08	52.30
52.40	2372.08	2372.59	2373.11	2373.63	2374.14	2374.66	2375.17	2375.69	2376.21	2376.72	2377.24	52.40
52.50	2377.24	2377.76	2378.27	2378.79	2379.31	2379.82	2380.34	2380.86	2381.37	2381.89	2382.41	52.50
52.60	2382.41	2382.93	2383.44	2383.96	2384.48	2384.99	2385.51	2386.03	2386.55	2387.07	2387.58	52.60
52.70	2387.58	2388.10	2388.62	2389.14	2389.65	2390.17	2390.69	2391.21	2391.73	2392.25	2392.76	52.70
52.80	2392.76	2393.28	2393.80	2394.32	2394.84	2395.36	2395.88	2396.39	2396.91	2397.43	2397.95	52.80
52.90	2397.95	2398.47	2398.99	2399.51	2400.03	2400.55	2401.07	2401.59	2402.11	2402.63	2403.15	52.90
53.00	2403.15	2403.67	2404.19	2404.71	2405.23	2405.75	2406.27	2406.79	2407.31	2407.83	2408.35	53.00
53.10	2408.35	2408.87	2409.39	2409.91	2410.43	2410.95	2411.47	2411.99	2412.51	2413.03	2413.55	53.10
53.20	2413.55	2414.07	2414.60	2415.12	2415.64	2416.16	2416.68	2417.20	2417.72	2418.25	2418.77	53.20
53.30	2418.77	2419.29	2419.81	2420.33	2420.85	2421.38	2421.90	2422.42	2422.94	2423.46	2423.99	53.30
53.40	2423.99	2424.51	2425.03	2425.55	2426.08	2426.60	2427.12	2427.64	2428.17	2428.69	2429.21	53.40
53.50	2429.21	2429.73	2430.26	2430.78	2431.30	2431.83	2432.35	2432.87	2433.40	2433.92	2434.44	53.50
53.60	2434.44	2434.97	2435.49	2436.01	2436.54	2437.06	2437.58	2438.11	2438.63	2439.16	2439.68	53.60
53.70	2439.68	2440.20	2440.73	2441.25	2441.78	2442.30	2442.83	2443.35	2443.87	2444.40	2444.92	53.70
53.80	2444.92	2445.45	2445.97	2446.50	2447.02	2447.55	2448.07	2448.60	2449.12	2449.65	2450.17	53.80
53.90	2450.17	2450.70	2451.22	2451.75	2452.27	2452.80	2453.32	2453.85	2454.37	2454.90	2455.43	53.90
54.00	2455.43	2455.95	2456.48	2457.00	2457.53	2458.06	2458.58	2459.11	2459.63	2460.16	2460.69	54.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.2. *Type K thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
54.00	2455.43	2455.95	2456.48	2457.00	2457.53	2458.06	2458.58	2459.11	2459.63	2460.16	2460.69	54.00
54.10	2460.69	2461.21	2461.74	2462.26	2462.79	2463.32	2463.84	2464.37	2464.90	2465.42	2465.95	54.10
54.20	2465.95	2466.48	2467.00	2467.53	2468.06	2468.58	2469.11	2469.64	2470.17	2470.69	2471.22	54.20
54.30	2471.22	2471.75	2472.27	2472.80	2473.33	2473.86	2474.38	2474.91	2475.44	2475.97	2476.49	54.30
54.40	2476.49	2477.02	2477.55	2478.08	2478.60	2479.13	2479.66	2480.19	2480.72	2481.24	2481.77	54.40
54.50	2481.77	2482.30	2482.83	2483.36	2483.89	2484.41	2484.94	2485.47	2486.00	2486.53	2487.06	54.50
54.60	2487.06	2487.58	2488.11	2488.64	2489.17	2489.70	2490.23	2490.76	2491.29	2491.81	2492.34	54.60
54.70	2492.34	2492.87	2493.40	2493.93	2494.46	2494.99	2495.52	2496.05	2496.58	2497.11	2497.63	54.70
54.80	2497.63	2498.16	2498.69	2499.22	2499.75	2500.28	2500.81	2501.34				54.80
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A7.2.3. *Type K thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges (°C). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius*

Temperature Range (°C)	a_0		a_1		a_2		a_3		a_4		Error Range (°C)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
-270 to 0	.....	..	1.2329875	-2	-1.4434305	-5	-4.2824995	-9	-4.2028679	-13	-11 to .8
-200 to 0	.....	..	2.3783697	-2	-2.4382217	-6	-6.8203073	-10	-9.4854031	-14	-.5 to .5
-200 to 800	.....	..	2.8346886	-2	-5.8008526	-7	2.5720615	-11	-3.6813679	-16	-8 to 10
-20 to 500	.....	..	2.4363851	-2	5.6206931	-8	-3.8825620	-12	3.9120208	-17	-1.2 to .6
0 to 400	.....	..	2.4383248	-2	9.7830251	-9	3.6276965	-12	-2.5756438	-16	-.5 to .6
0 to 1370	.....	..	2.5132785	-2	-6.0883423	-8	5.5358209	-13	9.3720918	-18	-2.4 to 1.2
400 to 1000	-2.4707112	+1	2.9465633	-2	-3.1332620	-7	6.5075717	-12	-3.9663834	-17	-.02 to .02
400 to 1370	6.2300671	+0	2.4955374	-2	-7.8788333	-8	1.3269743	-12	1.5580541	-18	-.3 to .3
600 to 800	-3.9480992	+1	3.1425797	-2	-4.0905633	-7	8.5482602	-12	-5.5696636	-17	-.001 to .001
850 to 1000	-3.1617495	+0	2.7115517	-2	-2.1941995	-7	4.8782826	-12	-2.9316611	-17	-.0012 to .0012
1050 to 1150	2.3615582	+2	1.1066277	-3	8.2516607	-7	-1.3558849	-11	9.1638500	-17	-.001 to .001
II. Cubic Equation											
-270 to 0	.....	..	3.7031567	-2	6.8919680	-6	1.1244287	-9	.....	..	-16 to 10
-200 to 0	.....	..	2.7891399	-2	1.4926570	-6	4.2157153	-10	.....	..	-1.3 to 1.2
-200 to 800	.....	..	2.8553599	-2	-3.6679062	-7	7.1156035	-12	.....	..	-18 to 7
-20 to 500	.....	..	2.4428628	-2	3.7535481	-8	-2.3295275	-12	.....	..	-1.1 to .6
0 to 400	.....	..	2.4153681	-2	9.0047640	-8	-4.6004855	-12	.....	..	-.6 to .8
0 to 1370	.....	..	2.5439047	-2	-9.3297004	-8	1.5521594	-12	.....	..	-3.2 to 1.2
400 to 1000	-2.1833545	+0	2.6006699	-2	-1.2132890	-7	1.9304990	-12	.....	..	-.5 to .5
400 to 1370	4.4041973	+0	2.5198680	-2	-9.0154824	-8	1.5496930	-12	.....	..	-.3 to .3
600 to 800	-2.8636527	-1	2.5984415	-2	-1.2676511	-7	2.0620304	-12	.....	..	-.003 to .003
850 to 1000	5.9524244	+1	2.0548488	-2	3.8308685	-8	3.8732336	-13	.....	..	-.001 to .001
1050 to 1150	-1.4211929	+2	3.4690180	-2	-2.9259543	-7	2.9707233	-12	.....	..	-.001 to .001
III. Quadratic Equation											
-270 to 0	.....	..	1.4537885	-2	-3.6430496	-6	.....	..	.....	..	-25 to 13
-200 to 0	.....	..	2.1080616	-2	-2.0618373	-6	.....	..	.....	..	-4.5 to 3.5
-200 to 800	.....	..	2.6112875	-2	-7.2451071	-8	.....	..	.....	..	-45 to 12
-20 to 500	.....	..	2.4860578	-2	-2.9525505	-8	.....	..	.....	..	-1.6 to .8
0 to 400	.....	..	2.4689438	-2	-1.4594344	-8	.....	..	.....	..	-1.1 to 1.0
0 to 1370	.....	..	2.3405437	-2	2.5074673	-8	.....	..	.....	..	-.9 to 12
400 to 1000	3.8025098	+1	2.1401089	-2	4.5686566	-8	.....	..	.....	..	-1.2 to 1.0
400 to 1370	5.8997501	+1	1.9745441	-2	7.5044894	-8	.....	..	.....	..	-3 to 3.5
600 to 800	4.9507604	+1	2.0790061	-2	5.2938546	-8	.....	..	.....	..	-.05 to .05
850 to 1000	8.1170593	+1	1.8847481	-2	8.2799269	-8	.....	..	.....	..	-.003 to .003
1050 to 1150	1.2994246	+2	1.6574989	-2	1.0929505	-7	.....	..	.....	..	-.006 to .006

A8. Supplementary Data for Type T—Copper Versus Copper–Nickel Alloy Thermocouples

A8.1. Data for Voltage as a Function of Temperature

The full precision coefficients given in the main text are used to generate the voltage as a function of temperature data given in tables A8.1.1 and A8.1.2. Table A8.1.1 presents the data in degrees Celsius from -270°C to 400°C while table A8.1.2 presents the data in degrees Fahrenheit from -454°F to 752°F . Table 8.1.3 contains quadratic, cubic, and quartic approximations to the data as a function of temperature in selected temperature ranges. The error range given in the table is the difference between the voltage as obtained from the full precision coefficients from the text and the respective reduced order approximations. The last entries in the cubic and quadratic groupings of table A8.1.3 represent variable reference junction corrections in the 0 to 50°C temperature range. In the narrower temperature range near room temperatures, 20 to 25°C , the error range for the given *quadratic* equation is smaller than that listed in the last column: $\pm 0.1\ \mu\text{V}$.

TABLE A8.1.1. *Type T thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{C}$), reference junctions at 0°C*

$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-270	-6.258											-270
-260	-6.232	-6.236	-6.239	-6.242	-6.245	-6.248	-6.251	-6.253	-6.255	-6.256	-6.258	-260
-250	-6.181	-6.187	-6.193	-6.198	-6.204	-6.209	-6.214	-6.219	-6.224	-6.228	-6.232	-250
-240	-6.105	-6.114	-6.122	-6.130	-6.138	-6.146	-6.153	-6.160	-6.167	-6.174	-6.181	-240
-230	-6.007	-6.018	-6.028	-6.039	-6.049	-6.059	-6.068	-6.078	-6.087	-6.096	-6.105	-230
-220	-5.889	-5.901	-5.914	-5.926	-5.938	-5.950	-5.962	-5.973	-5.985	-5.996	-6.007	-220
-210	-5.753	-5.767	-5.782	-5.795	-5.809	-5.823	-5.836	-5.850	-5.863	-5.876	-5.889	-210
-200	-5.603	-5.619	-5.634	-5.650	-5.665	-5.680	-5.695	-5.710	-5.724	-5.739	-5.753	-200
-190	-5.439	-5.456	-5.473	-5.489	-5.506	-5.522	-5.539	-5.555	-5.571	-5.587	-5.603	-190
-180	-5.261	-5.279	-5.297	-5.315	-5.333	-5.351	-5.369	-5.387	-5.404	-5.421	-5.439	-180
-170	-5.069	-5.089	-5.109	-5.128	-5.147	-5.167	-5.186	-5.205	-5.223	-5.242	-5.261	-170
-160	-4.865	-4.886	-4.907	-4.928	-4.948	-4.969	-4.989	-5.010	-5.030	-5.050	-5.069	-160
-150	-4.648	-4.670	-4.693	-4.715	-4.737	-4.758	-4.780	-4.801	-4.823	-4.844	-4.865	-150
-140	-4.419	-4.442	-4.466	-4.489	-4.512	-4.535	-4.558	-4.581	-4.603	-4.626	-4.648	-140
-130	-4.177	-4.202	-4.226	-4.251	-4.275	-4.299	-4.323	-4.347	-4.371	-4.395	-4.419	-130
-120	-3.923	-3.949	-3.974	-4.000	-4.026	-4.051	-4.077	-4.102	-4.127	-4.152	-4.177	-120
-110	-3.656	-3.684	-3.711	-3.737	-3.764	-3.791	-3.818	-3.844	-3.870	-3.897	-3.923	-110
-100	-3.378	-3.407	-3.435	-3.463	-3.491	-3.519	-3.547	-3.574	-3.602	-3.629	-3.656	-100
-90	-3.089	-3.118	-3.147	-3.177	-3.206	-3.235	-3.264	-3.293	-3.321	-3.350	-3.378	-90
-80	-2.788	-2.818	-2.849	-2.879	-2.909	-2.939	-2.970	-2.999	-3.029	-3.059	-3.089	-80
-70	-2.475	-2.507	-2.539	-2.570	-2.602	-2.633	-2.664	-2.695	-2.726	-2.757	-2.788	-70
-60	-2.152	-2.185	-2.218	-2.250	-2.283	-2.315	-2.348	-2.380	-2.412	-2.444	-2.475	-60
-50	-1.819	-1.853	-1.886	-1.920	-1.953	-1.987	-2.020	-2.053	-2.087	-2.120	-2.152	-50
-40	-1.475	-1.510	-1.544	-1.579	-1.614	-1.648	-1.682	-1.717	-1.751	-1.785	-1.819	-40
-30	-1.121	-1.157	-1.192	-1.228	-1.263	-1.299	-1.334	-1.370	-1.405	-1.440	-1.475	-30
-20	-0.757	-0.794	-0.830	-0.867	-0.903	-0.940	-0.976	-1.013	-1.049	-1.085	-1.121	-20
-10	-0.383	-0.421	-0.458	-0.496	-0.534	-0.571	-0.608	-0.646	-0.683	-0.720	-0.757	-10
-0	0.000	-0.039	-0.077	-0.116	-0.154	-0.193	-0.231	-0.269	-0.307	-0.345	-0.383	-0
$^{\circ}\text{C}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{C}$

TABLE A8.1.1. Type T thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0 °C—Continued

°C	0	1	2	3	4	5	6	7	8	9	10	°C
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	0.000	0.039	0.078	0.117	0.156	0.195	0.234	0.273	0.312	0.351	0.391	0
10	0.391	0.430	0.470	0.510	0.549	0.589	0.629	0.669	0.709	0.749	0.789	10
20	0.789	0.830	0.870	0.911	0.951	0.992	1.032	1.073	1.114	1.155	1.196	20
30	1.196	1.237	1.279	1.320	1.361	1.403	1.444	1.486	1.528	1.569	1.611	30
40	1.611	1.653	1.695	1.738	1.780	1.822	1.865	1.907	1.950	1.992	2.035	40
50	2.035	2.078	2.121	2.164	2.207	2.250	2.294	2.337	2.380	2.424	2.467	50
60	2.467	2.511	2.555	2.599	2.643	2.687	2.731	2.775	2.819	2.864	2.908	60
70	2.908	2.953	2.997	3.042	3.087	3.131	3.176	3.221	3.266	3.312	3.357	70
80	3.357	3.402	3.447	3.493	3.538	3.584	3.630	3.676	3.721	3.767	3.813	80
90	3.813	3.859	3.906	3.952	3.998	4.044	4.091	4.137	4.184	4.231	4.277	90
100	4.277	4.324	4.371	4.418	4.465	4.512	4.559	4.607	4.654	4.701	4.749	100
110	4.749	4.796	4.844	4.891	4.939	4.987	5.035	5.083	5.131	5.179	5.227	110
120	5.227	5.275	5.324	5.372	5.420	5.469	5.517	5.566	5.615	5.663	5.712	120
130	5.712	5.761	5.810	5.859	5.908	5.957	6.007	6.056	6.105	6.155	6.204	130
140	6.204	6.254	6.303	6.353	6.403	6.452	6.502	6.552	6.602	6.652	6.702	140
150	6.702	6.753	6.803	6.853	6.903	6.954	7.004	7.055	7.106	7.156	7.207	150
160	7.207	7.258	7.309	7.360	7.411	7.462	7.513	7.564	7.615	7.666	7.718	160
170	7.718	7.769	7.821	7.872	7.924	7.975	8.027	8.079	8.131	8.183	8.235	170
180	8.235	8.287	8.339	8.391	8.443	8.495	8.548	8.600	8.652	8.705	8.757	180
190	8.757	8.810	8.863	8.915	8.968	9.021	9.074	9.127	9.180	9.233	9.286	190
200	9.286	9.339	9.392	9.446	9.499	9.553	9.606	9.659	9.713	9.767	9.820	200
210	9.820	9.874	9.928	9.982	10.036	10.090	10.144	10.198	10.252	10.306	10.360	210
220	10.360	10.414	10.469	10.523	10.578	10.632	10.687	10.741	10.796	10.851	10.905	220
230	10.905	10.960	11.015	11.070	11.125	11.180	11.235	11.290	11.345	11.401	11.456	230
240	11.456	11.511	11.566	11.622	11.677	11.733	11.788	11.844	11.900	11.956	12.011	240
250	12.011	12.067	12.123	12.179	12.235	12.291	12.347	12.403	12.459	12.515	12.572	250
260	12.572	12.628	12.684	12.741	12.797	12.854	12.910	12.967	13.024	13.080	13.137	260
270	13.137	13.194	13.251	13.307	13.364	13.421	13.478	13.535	13.592	13.650	13.707	270
280	13.707	13.764	13.821	13.879	13.936	13.993	14.051	14.108	14.166	14.223	14.281	280
290	14.281	14.339	14.396	14.454	14.512	14.570	14.628	14.686	14.744	14.802	14.860	290
300	14.860	14.918	14.976	15.034	15.092	15.151	15.209	15.267	15.326	15.384	15.443	300
310	15.443	15.501	15.560	15.619	15.677	15.736	15.795	15.853	15.912	15.971	16.030	310
320	16.030	16.089	16.148	16.207	16.266	16.325	16.384	16.444	16.503	16.562	16.621	320
330	16.621	16.681	16.740	16.800	16.859	16.919	16.978	17.038	17.097	17.157	17.217	330
340	17.217	17.277	17.336	17.396	17.456	17.516	17.576	17.636	17.696	17.756	17.816	340
350	17.816	17.877	17.937	17.997	18.057	18.118	18.178	18.238	18.299	18.359	18.420	350
360	18.420	18.480	18.541	18.602	18.662	18.723	18.784	18.845	18.905	18.966	19.027	360
370	19.027	19.088	19.149	19.210	19.271	19.332	19.393	19.455	19.516	19.577	19.638	370
380	19.638	19.699	19.761	19.822	19.883	19.945	20.006	20.068	20.129	20.191	20.252	380
390	20.252	20.314	20.376	20.437	20.499	20.560	20.622	20.684	20.746	20.807	20.869	390
400	20.869											400
°C	0	1	2	3	4	5	6	7	8	9	10	°C

TABLE A8.1.2. Type T thermocouples—thermoelectric voltage as a function of temperature ($^{\circ}\text{F}$), reference junctions at 32°F

$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
-450	-6.254	-6.255	-6.256	-6.257	-6.258							-450
-440	-6.240	-6.242	-6.243	-6.245	-6.247	-6.248	-6.250	-6.251	-6.252	-6.253	-6.254	-440
-430	-6.217	-6.220	-6.223	-6.225	-6.227	-6.230	-6.232	-6.234	-6.236	-6.238	-6.240	-430
-420	-6.187	-6.191	-6.194	-6.197	-6.200	-6.203	-6.206	-6.209	-6.212	-6.215	-6.217	-420
-410	-6.150	-6.154	-6.158	-6.162	-6.166	-6.170	-6.173	-6.177	-6.181	-6.184	-6.187	-410
-400	-6.105	-6.110	-6.115	-6.119	-6.124	-6.128	-6.133	-6.137	-6.142	-6.146	-6.150	-400
-390	-6.053	-6.059	-6.064	-6.069	-6.075	-6.080	-6.085	-6.090	-6.095	-6.100	-6.105	-390
-380	-5.995	-6.001	-6.007	-6.013	-6.019	-6.025	-6.030	-6.036	-6.042	-6.048	-6.053	-380
-370	-5.930	-5.937	-5.943	-5.950	-5.957	-5.963	-5.969	-5.976	-5.982	-5.988	-5.995	-370
-360	-5.860	-5.867	-5.874	-5.881	-5.889	-5.896	-5.903	-5.910	-5.916	-5.923	-5.930	-360
-350	-5.785	-5.792	-5.800	-5.808	-5.815	-5.823	-5.830	-5.838	-5.845	-5.853	-5.860	-350
-340	-5.705	-5.713	-5.721	-5.729	-5.737	-5.745	-5.753	-5.761	-5.769	-5.777	-5.785	-340
-330	-5.620	-5.629	-5.638	-5.646	-5.655	-5.663	-5.672	-5.680	-5.688	-5.697	-5.705	-330
-320	-5.532	-5.541	-5.550	-5.559	-5.568	-5.576	-5.585	-5.594	-5.603	-5.612	-5.620	-320
-310	-5.439	-5.448	-5.457	-5.467	-5.476	-5.486	-5.495	-5.504	-5.513	-5.522	-5.532	-310
-300	-5.341	-5.351	-5.361	-5.371	-5.381	-5.390	-5.400	-5.410	-5.419	-5.429	-5.439	-300
-290	-5.240	-5.250	-5.261	-5.271	-5.281	-5.291	-5.301	-5.311	-5.321	-5.331	-5.341	-290
-280	-5.135	-5.145	-5.156	-5.167	-5.177	-5.188	-5.198	-5.209	-5.219	-5.230	-5.240	-280
-270	-5.025	-5.036	-5.047	-5.058	-5.069	-5.080	-5.091	-5.102	-5.113	-5.124	-5.135	-270
-260	-4.912	-4.923	-4.935	-4.946	-4.958	-4.969	-4.980	-4.992	-5.003	-5.014	-5.025	-260
-250	-4.794	-4.806	-4.818	-4.830	-4.842	-4.853	-4.865	-4.877	-4.889	-4.900	-4.912	-250
-240	-4.673	-4.685	-4.698	-4.710	-4.722	-4.734	-4.746	-4.758	-4.770	-4.782	-4.794	-240
-230	-4.548	-4.560	-4.573	-4.586	-4.598	-4.611	-4.623	-4.636	-4.648	-4.661	-4.673	-230
-220	-4.419	-4.432	-4.445	-4.458	-4.471	-4.484	-4.497	-4.509	-4.522	-4.535	-4.548	-220
-210	-4.286	-4.299	-4.313	-4.326	-4.339	-4.353	-4.366	-4.379	-4.392	-4.406	-4.419	-210
-200	-4.149	-4.163	-4.177	-4.191	-4.204	-4.218	-4.232	-4.245	-4.259	-4.272	-4.286	-200
-190	-4.009	-4.023	-4.037	-4.051	-4.065	-4.079	-4.093	-4.107	-4.121	-4.135	-4.149	-190
-180	-3.864	-3.879	-3.894	-3.908	-3.923	-3.937	-3.951	-3.966	-3.980	-3.994	-4.009	-180
-170	-3.717	-3.732	-3.746	-3.761	-3.776	-3.791	-3.806	-3.820	-3.835	-3.850	-3.864	-170
-160	-3.565	-3.580	-3.596	-3.611	-3.626	-3.641	-3.656	-3.671	-3.687	-3.702	-3.717	-160
-150	-3.410	-3.425	-3.441	-3.457	-3.472	-3.488	-3.503	-3.519	-3.534	-3.550	-3.565	-150
-140	-3.251	-3.267	-3.283	-3.299	-3.315	-3.331	-3.347	-3.362	-3.378	-3.394	-3.410	-140
-130	-3.089	-3.105	-3.121	-3.138	-3.154	-3.170	-3.186	-3.203	-3.219	-3.235	-3.251	-130
-120	-2.923	-2.939	-2.956	-2.973	-2.989	-3.006	-3.023	-3.039	-3.056	-3.072	-3.089	-120
-110	-2.753	-2.771	-2.788	-2.805	-2.822	-2.838	-2.855	-2.872	-2.889	-2.906	-2.923	-110
-100	-2.581	-2.598	-2.616	-2.633	-2.650	-2.667	-2.685	-2.702	-2.719	-2.736	-2.753	-100
-90	-2.405	-2.422	-2.440	-2.458	-2.475	-2.493	-2.511	-2.528	-2.546	-2.563	-2.581	-90
-80	-2.225	-2.243	-2.261	-2.279	-2.297	-2.315	-2.333	-2.351	-2.369	-2.387	-2.405	-80
-70	-2.042	-2.061	-2.079	-2.098	-2.116	-2.134	-2.152	-2.171	-2.189	-2.207	-2.225	-70
-60	-1.856	-1.875	-1.894	-1.912	-1.931	-1.950	-1.968	-1.987	-2.005	-2.024	-2.042	-60
-50	-1.667	-1.686	-1.705	-1.724	-1.743	-1.762	-1.781	-1.800	-1.819	-1.838	-1.856	-50
-40	-1.475	-1.494	-1.513	-1.533	-1.552	-1.571	-1.591	-1.610	-1.629	-1.648	-1.667	-40
-30	-1.279	-1.299	-1.319	-1.338	-1.358	-1.377	-1.397	-1.416	-1.436	-1.455	-1.475	-30
-20	-1.081	-1.101	-1.121	-1.141	-1.160	-1.180	-1.200	-1.220	-1.240	-1.260	-1.279	-20
-10	-0.879	-0.899	-0.920	-0.940	-0.960	-0.980	-1.000	-1.021	-1.041	-1.061	-1.081	-10
-0	-0.674	-0.695	-0.716	-0.736	-0.757	-0.777	-0.798	-0.818	-0.838	-0.859	-0.879	-0
$^{\circ}\text{F}$	0	1	2	3	4	5	6	7	8	9	10	$^{\circ}\text{F}$

TABLE A8.1.2. Type T thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
0	-0.674	-0.654	-0.633	-0.613	-0.592	-0.571	-0.550	-0.529	-0.509	-0.488	-0.467	0
10	-0.467	-0.446	-0.425	-0.404	-0.383	-0.362	-0.341	-0.320	-0.299	-0.277	-0.256	10
20	-0.256	-0.235	-0.214	-0.193	-0.171	-0.150	-0.129	-0.107	-0.086	-0.064	-0.043	20
30	-0.043	-0.022	0.000	0.022	0.043	0.065	0.086	0.108	0.130	0.151	0.173	30
40	0.173	0.195	0.216	0.238	0.260	0.282	0.303	0.325	0.347	0.369	0.391	40
50	0.391	0.413	0.435	0.457	0.479	0.501	0.523	0.545	0.567	0.589	0.611	50
60	0.611	0.634	0.656	0.678	0.700	0.722	0.745	0.767	0.789	0.812	0.834	60
70	0.834	0.857	0.879	0.902	0.924	0.947	0.969	0.992	1.014	1.037	1.060	70
80	1.060	1.082	1.105	1.128	1.151	1.173	1.196	1.219	1.242	1.265	1.288	80
90	1.288	1.311	1.334	1.357	1.380	1.403	1.426	1.449	1.472	1.495	1.518	90
100	1.518	1.542	1.565	1.588	1.611	1.635	1.658	1.681	1.705	1.728	1.752	100
110	1.752	1.775	1.799	1.822	1.846	1.869	1.893	1.917	1.940	1.964	1.988	110
120	1.988	2.011	2.035	2.059	2.083	2.107	2.131	2.154	2.178	2.202	2.226	120
130	2.226	2.250	2.274	2.298	2.322	2.347	2.371	2.395	2.419	2.443	2.467	130
140	2.467	2.492	2.516	2.540	2.565	2.589	2.613	2.638	2.662	2.687	2.711	140
150	2.711	2.736	2.760	2.785	2.809	2.834	2.859	2.883	2.908	2.933	2.958	150
160	2.958	2.982	3.007	3.032	3.057	3.082	3.107	3.131	3.156	3.181	3.206	160
170	3.206	3.231	3.256	3.281	3.307	3.332	3.357	3.382	3.407	3.432	3.458	170
180	3.458	3.483	3.508	3.533	3.559	3.584	3.609	3.635	3.660	3.686	3.711	180
190	3.711	3.737	3.762	3.788	3.813	3.839	3.864	3.890	3.916	3.941	3.967	190
200	3.967	3.993	4.019	4.044	4.070	4.096	4.122	4.148	4.174	4.199	4.225	200
210	4.225	4.251	4.277	4.303	4.329	4.355	4.381	4.408	4.434	4.460	4.486	210
220	4.486	4.512	4.538	4.565	4.591	4.617	4.643	4.670	4.696	4.722	4.749	220
230	4.749	4.775	4.801	4.828	4.854	4.881	4.907	4.934	4.960	4.987	5.014	230
240	5.014	5.040	5.067	5.093	5.120	5.147	5.174	5.200	5.227	5.254	5.281	240
250	5.281	5.307	5.334	5.361	5.388	5.415	5.442	5.469	5.496	5.523	5.550	250
260	5.550	5.577	5.604	5.631	5.658	5.685	5.712	5.739	5.767	5.794	5.821	260
270	5.821	5.848	5.875	5.903	5.930	5.957	5.985	6.012	6.039	6.067	6.094	270
280	6.094	6.122	6.149	6.177	6.204	6.232	6.259	6.287	6.314	6.342	6.369	280
290	6.369	6.397	6.425	6.452	6.480	6.508	6.536	6.563	6.591	6.619	6.647	290
300	6.647	6.675	6.702	6.730	6.758	6.786	6.814	6.842	6.870	6.898	6.926	300
310	6.926	6.954	6.982	7.010	7.038	7.066	7.094	7.122	7.151	7.179	7.207	310
320	7.207	7.235	7.263	7.292	7.320	7.348	7.377	7.405	7.433	7.462	7.490	320
330	7.490	7.518	7.547	7.575	7.604	7.632	7.661	7.689	7.718	7.746	7.775	330
340	7.775	7.804	7.832	7.861	7.889	7.918	7.947	7.975	8.004	8.033	8.062	340
350	8.062	8.090	8.119	8.148	8.177	8.206	8.235	8.264	8.292	8.321	8.350	350
360	8.350	8.379	8.408	8.437	8.466	8.495	8.524	8.553	8.583	8.612	8.641	360
370	8.641	8.670	8.699	8.728	8.757	8.787	8.816	8.845	8.874	8.904	8.933	370
380	8.933	8.962	8.992	9.021	9.050	9.080	9.109	9.139	9.168	9.198	9.227	380
390	9.227	9.257	9.286	9.316	9.345	9.375	9.404	9.434	9.464	9.493	9.523	390
400	9.523	9.553	9.582	9.612	9.642	9.671	9.701	9.731	9.761	9.791	9.820	400
410	9.820	9.850	9.880	9.910	9.940	9.970	10.000	10.030	10.060	10.090	10.120	410
420	10.120	10.150	10.180	10.210	10.240	10.270	10.300	10.330	10.360	10.390	10.420	420
430	10.420	10.451	10.481	10.511	10.541	10.572	10.602	10.632	10.662	10.693	10.723	430
440	10.723	10.753	10.784	10.814	10.845	10.875	10.905	10.936	10.966	10.997	11.027	440
450	11.027	11.058	11.088	11.119	11.149	11.180	11.211	11.241	11.272	11.302	11.333	450
460	11.333	11.364	11.394	11.425	11.456	11.487	11.517	11.548	11.579	11.610	11.640	460
470	11.640	11.671	11.702	11.733	11.764	11.795	11.826	11.856	11.887	11.918	11.949	470
480	11.949	11.980	12.011	12.042	12.073	12.104	12.135	12.166	12.198	12.229	12.260	480
490	12.260	12.291	12.322	12.353	12.384	12.416	12.447	12.478	12.509	12.540	12.572	490
500	12.572	12.603	12.634	12.666	12.697	12.728	12.760	12.791	12.822	12.854	12.885	500
510	12.885	12.917	12.948	12.979	13.011	13.042	13.074	13.105	13.137	13.168	13.200	510
520	13.200	13.232	13.263	13.295	13.326	13.358	13.390	13.421	13.453	13.485	13.516	520
530	13.516	13.548	13.580	13.611	13.643	13.675	13.707	13.739	13.770	13.802	13.834	530
540	13.834	13.866	13.898	13.930	13.961	13.993	14.025	14.057	14.089	14.121	14.153	540
550	14.153	14.185	14.217	14.249	14.281	14.313	14.345	14.377	14.409	14.441	14.474	550
560	14.474	14.506	14.538	14.570	14.602	14.634	14.666	14.699	14.731	14.763	14.795	560
570	14.795	14.828	14.860	14.892	14.924	14.957	14.989	15.021	15.054	15.086	15.118	570
580	15.118	15.151	15.183	15.216	15.248	15.280	15.313	15.345	15.378	15.410	15.443	580
590	15.443	15.475	15.508	15.540	15.573	15.605	15.638	15.671	15.703	15.736	15.769	590
600	15.769	15.801	15.834	15.866	15.899	15.932	15.965	15.997	16.030	16.063	16.096	600
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A8.1.2. Type T thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32 °F—Continued

°F	0	1	2	3	4	5	6	7	8	9	10	°F
THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS												
600	15.769	15.801	15.834	15.866	15.899	15.932	15.965	15.997	16.030	16.063	16.096	600
610	16.096	16.128	16.161	16.194	16.227	16.259	16.292	16.325	16.358	16.391	16.424	610
620	16.424	16.457	16.490	16.523	16.555	16.588	16.621	16.654	16.687	16.720	16.753	620
630	16.753	16.786	16.819	16.852	16.886	16.919	16.952	16.985	17.018	17.051	17.084	630
640	17.084	17.117	17.150	17.184	17.217	17.250	17.283	17.316	17.350	17.383	17.416	640
650	17.416	17.450	17.483	17.516	17.549	17.583	17.616	17.649	17.683	17.716	17.750	650
660	17.750	17.783	17.816	17.850	17.883	17.917	17.950	17.984	18.017	18.051	18.084	660
670	18.084	18.118	18.151	18.185	18.218	18.252	18.285	18.319	18.353	18.386	18.420	670
680	18.420	18.454	18.487	18.521	18.555	18.588	18.622	18.656	18.689	18.723	18.757	680
690	18.757	18.791	18.824	18.858	18.892	18.926	18.960	18.993	19.027	19.061	19.095	690
700	19.095	19.129	19.163	19.197	19.230	19.264	19.298	19.332	19.366	19.400	19.434	700
710	19.434	19.468	19.502	19.536	19.570	19.604	19.638	19.672	19.706	19.740	19.774	710
720	19.774	19.808	19.843	19.877	19.911	19.945	19.979	20.013	20.047	20.081	20.115	720
730	20.115	20.150	20.184	20.218	20.252	20.287	20.321	20.355	20.389	20.423	20.458	730
740	20.458	20.492	20.526	20.560	20.595	20.629	20.663	20.698	20.732	20.766	20.801	740
750	20.801	20.835	20.869									750
°F	0	1	2	3	4	5	6	7	8	9	10	°F

TABLE A8.1.3. Type T thermocouples—quadratic, cubic, and quartic approximations to the data as a function of temperature (°C) in selected temperature ranges. The expansion is of the form $E = a_0 + a_1T + a_2T^2 + a_3T^3 + a_4T^4$ where E is in microvolts and T is in degrees Celsius

Temperature Range (°C)	a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (μV)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Exact-Approx.
I. Quartic Equation											
-270 to 0	3.9439919	+1	6.2407452	-2	8.0773568	-5	2.6845647	-7	-9 to 7
-200 to 0	3.8749056	+1	4.5149809	-2	-4.7759448	-5	-2.5773959	-8	-.14 to .13
-200 to 400	3.8621703	+1	4.5433050	-2	-3.4731838	-5	1.4661300	-8	-7 to 3.5
0 to 400	3.8468407	+1	4.6651731	-2	-3.7375793	-5	1.5999833	-8	-.9 to .9
II. Cubic Equation											
-270 to 0	3.8286972	+1	3.8845536	-2	-6.2566256	-5	.....	..	-16 to 17
-200 to 0	3.8795175	+1	4.6406525	-2	-3.7515430	-5	.....	..	-.4 to .45
-200 to 400	3.8419940	+1	4.5812964	-2	-2.8715275	-5	.....	..	-24 to 19
0 to 400	3.8666983	+1	4.3739444	-2	-2.4974186	-5	.....	..	-5 to 3
Variable reference junction correction											
0 to 50	3.8680238	+1	4.1277001	-2	.....	..	.....	..	-0.04 to +0.08
III. Quadratic Equation											
-270 to 0	4.0295768	+1	6.2411289	-2	.....	..	.....	..	-45 to 75
-200 to 0	3.9460429	+1	5.6897673	-2	.....	..	.....	..	-10 to 14
-200 to 400	3.7311396	+1	3.9301943	-2	.....	..	.....	..	-350 to 300
0 to 400	4.0381232	+1	2.9943775	-2	.....	..	.....	..	-75 to 55
Variable reference junction correction											
0 to 50	3.8642926	+1	4.1277001	-2	.....	..	.....	..	-0.4 to +0.2

A8.2. Data for Temperature as a Function of Voltage

The temperature as a function of voltage data given in tables A8.2.1 and A8.2.2 were obtained by iteration in the primary equations for voltage as a function of temperature. Table A8.2.1 presents the data in millivolts from -6.25 mV to 20.86 mV with temperatures given in degrees Celsius while table A8.2.2 presents similar data with temperatures in degrees Fahrenheit. Table A8.2.3 contains quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges. The error range given in the table represents the difference between the temperature found by iteration in the full precision tables from the text and from the respective reduced order approximations.

TABLE A8.2.1. *Type T thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
-6.20	-253.28	-255.16	-257.22	-259.54	-262.25	-265.69						-6.20
-6.10	-239.42	-240.57	-241.75	-242.97	-244.24	-245.56	-246.94	-248.39	-249.92	-251.54	-253.28	-6.10
-6.00	-229.38	-230.30	-231.23	-232.18	-233.14	-234.13	-235.14	-236.17	-237.23	-238.31	-239.42	-6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.1. Type T thermocouples—temperature ($^{\circ}\text{C}$) as a function of thermoelectric voltage, reference junctions at 0°C —Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
-6.00	-229.38	-230.30	-231.23	-232.18	-233.14	-234.13	-235.14	-236.17	-237.23	-238.31	-239.42	-6.00
-5.90	-220.91	-221.71	-222.52	-223.33	-224.16	-225.00	-225.85	-226.72	-227.59	-228.48	-229.38	-5.90
-5.80	-213.33	-214.05	-214.79	-215.53	-216.27	-217.03	-217.79	-218.56	-219.33	-220.11	-220.91	-5.80
-5.70	-206.35	-207.02	-207.70	-208.39	-209.08	-209.77	-210.47	-211.18	-211.89	-212.60	-213.33	-5.70
-5.60	-199.81	-200.45	-201.09	-201.73	-202.38	-203.03	-203.69	-204.34	-205.01	-205.68	-206.35	-5.60
-5.50	-193.64	-194.24	-194.85	-195.46	-196.07	-196.69	-197.31	-197.93	-198.55	-199.18	-199.81	-5.50
-5.40	-187.77	-188.34	-188.92	-189.50	-190.08	-190.67	-191.26	-191.85	-192.44	-193.04	-193.64	-5.40
-5.30	-182.15	-182.70	-183.25	-183.81	-184.37	-184.93	-185.49	-186.06	-186.62	-187.20	-187.77	-5.30
-5.20	-176.75	-177.28	-177.82	-178.35	-178.89	-179.43	-179.97	-180.51	-181.05	-181.60	-182.15	-5.20
-5.10	-171.55	-172.07	-172.58	-173.10	-173.61	-174.13	-174.65	-175.17	-175.70	-176.23	-176.75	-5.10
-5.00	-166.53	-167.02	-167.52	-168.02	-168.52	-169.02	-169.52	-170.03	-170.54	-171.04	-171.55	-5.00
-4.90	-161.66	-162.14	-162.62	-163.11	-163.59	-164.08	-164.56	-165.05	-165.54	-166.04	-166.53	-4.90
-4.80	-156.93	-157.40	-157.87	-158.34	-158.81	-159.28	-159.75	-160.23	-160.70	-161.18	-161.66	-4.80
-4.70	-152.33	-152.79	-153.24	-153.70	-154.16	-154.62	-155.08	-155.54	-156.00	-156.47	-156.93	-4.70
-4.60	-147.85	-148.30	-148.74	-149.19	-149.63	-150.08	-150.53	-150.98	-151.43	-151.88	-152.33	-4.60
-4.50	-143.48	-143.91	-144.35	-144.78	-145.22	-145.65	-146.09	-146.53	-146.97	-147.41	-147.85	-4.50
-4.40	-139.21	-139.63	-140.05	-140.48	-140.90	-141.33	-141.76	-142.19	-142.62	-143.05	-143.48	-4.40
-4.30	-135.03	-135.44	-135.86	-136.27	-136.69	-137.11	-137.53	-137.94	-138.36	-138.79	-139.21	-4.30
-4.20	-130.94	-131.34	-131.75	-132.16	-132.56	-132.97	-133.38	-133.79	-134.20	-134.62	-135.03	-4.20
-4.10	-126.93	-127.32	-127.72	-128.12	-128.52	-128.92	-129.32	-129.73	-130.13	-130.53	-130.94	-4.10
-4.00	-122.99	-123.38	-123.77	-124.17	-124.56	-124.95	-125.34	-125.74	-126.13	-126.53	-126.93	-4.00
-3.90	-119.13	-119.52	-119.90	-120.28	-120.67	-121.05	-121.44	-121.83	-122.22	-122.60	-122.99	-3.90
-3.80	-115.34	-115.72	-116.09	-116.47	-116.85	-117.23	-117.61	-117.99	-118.37	-118.75	-119.13	-3.80
-3.70	-111.61	-111.98	-112.35	-112.72	-113.09	-113.47	-113.84	-114.21	-114.59	-114.96	-115.34	-3.70
-3.60	-107.94	-108.30	-108.67	-109.03	-109.40	-109.77	-110.13	-110.50	-110.87	-111.24	-111.61	-3.60
-3.50	-104.33	-104.69	-105.04	-105.40	-105.76	-106.13	-106.49	-106.85	-107.21	-107.58	-107.94	-3.50
-3.40	-100.77	-101.12	-101.48	-101.83	-102.18	-102.54	-102.90	-103.25	-103.61	-103.97	-104.33	-3.40
-3.30	-97.26	-97.61	-97.96	-98.31	-98.66	-99.01	-99.36	-99.71	-100.06	-100.41	-100.77	-3.30
-3.20	-93.80	-94.14	-94.49	-94.83	-95.18	-95.52	-95.87	-96.22	-96.56	-96.91	-97.26	-3.20
-3.10	-90.39	-90.73	-91.07	-91.41	-91.75	-92.09	-92.43	-92.77	-93.11	-93.46	-93.80	-3.10
-3.00	-87.02	-87.35	-87.69	-88.02	-88.36	-88.70	-89.03	-89.37	-89.71	-90.05	-90.39	-3.00
-2.90	-83.69	-84.02	-84.35	-84.69	-85.02	-85.35	-85.68	-86.02	-86.35	-86.68	-87.02	-2.90
-2.80	-80.41	-80.73	-81.06	-81.39	-81.72	-82.04	-82.37	-82.70	-83.03	-83.36	-83.69	-2.80
-2.70	-77.16	-77.48	-77.81	-78.13	-78.45	-78.78	-79.10	-79.43	-79.75	-80.08	-80.41	-2.70
-2.60	-73.95	-74.27	-74.59	-74.91	-75.23	-75.55	-75.87	-76.19	-76.51	-76.84	-77.16	-2.60
-2.50	-70.77	-71.09	-71.41	-71.72	-72.04	-72.36	-72.67	-72.99	-73.31	-73.63	-73.95	-2.50
-2.40	-67.63	-67.95	-68.26	-68.57	-68.89	-69.20	-69.51	-69.83	-70.14	-70.46	-70.77	-2.40
-2.30	-64.53	-64.84	-65.15	-65.46	-65.77	-66.08	-66.39	-66.70	-67.01	-67.32	-67.63	-2.30
-2.20	-61.45	-61.76	-62.06	-62.37	-62.68	-62.99	-63.29	-63.60	-63.91	-64.22	-64.53	-2.20
-2.10	-58.41	-58.71	-59.01	-59.32	-59.62	-59.93	-60.23	-60.54	-60.84	-61.15	-61.45	-2.10
-2.00	-55.39	-55.69	-55.99	-56.29	-56.60	-56.90	-57.20	-57.50	-57.80	-58.11	-58.41	-2.00
-1.90	-52.41	-52.70	-53.00	-53.30	-53.60	-53.90	-54.20	-54.49	-54.79	-55.09	-55.39	-1.90
-1.80	-49.45	-49.74	-50.04	-50.33	-50.63	-50.92	-51.22	-51.52	-51.81	-52.11	-52.41	-1.80
-1.70	-46.51	-46.81	-47.10	-47.39	-47.68	-47.98	-48.27	-48.56	-48.86	-49.15	-49.45	-1.70
-1.60	-43.61	-43.90	-44.19	-44.48	-44.77	-45.06	-45.35	-45.64	-45.93	-46.22	-46.51	-1.60
-1.50	-40.72	-41.01	-41.30	-41.59	-41.87	-42.16	-42.45	-42.74	-43.03	-43.32	-43.61	-1.50
-1.40	-37.87	-38.15	-38.44	-38.72	-39.01	-39.29	-39.58	-39.86	-40.15	-40.44	-40.72	-1.40
-1.30	-35.03	-35.31	-35.60	-35.88	-36.16	-36.44	-36.73	-37.01	-37.30	-37.58	-37.87	-1.30
-1.20	-32.22	-32.50	-32.78	-33.06	-33.34	-33.62	-33.90	-34.18	-34.47	-34.75	-35.03	-1.20
-1.10	-29.42	-29.70	-29.98	-30.26	-30.54	-30.82	-31.10	-31.38	-31.66	-31.94	-32.22	-1.10
-1.00	-26.65	-26.93	-27.21	-27.48	-27.76	-28.04	-28.31	-28.59	-28.87	-29.15	-29.42	-1.00
-0.90	-23.91	-24.18	-24.45	-24.73	-25.00	-25.28	-25.55	-25.83	-26.10	-26.38	-26.65	-0.90
-0.80	-21.18	-21.45	-21.72	-21.99	-22.27	-22.54	-22.81	-23.08	-23.36	-23.63	-23.91	-0.80
-0.70	-18.47	-18.74	-19.01	-19.28	-19.55	-19.82	-20.09	-20.36	-20.63	-20.90	-21.18	-0.70
-0.60	-15.78	-16.04	-16.31	-16.58	-16.85	-17.12	-17.39	-17.66	-17.93	-18.20	-18.47	-0.60
-0.50	-13.10	-13.37	-13.64	-13.90	-14.17	-14.44	-14.70	-14.97	-15.24	-15.51	-15.78	-0.50
-0.40	-10.45	-10.71	-10.98	-11.24	-11.51	-11.77	-12.04	-12.31	-12.57	-12.84	-13.10	-0.40
-0.30	-7.81	-8.08	-8.34	-8.60	-8.87	-9.13	-9.39	-9.66	-9.92	-10.19	-10.45	-0.30
-0.20	-5.19	-5.45	-5.72	-5.98	-6.24	-6.50	-6.76	-7.03	-7.29	-7.55	-7.81	-0.20
-0.10	-2.59	-2.85	-3.11	-3.37	-3.63	-3.89	-4.15	-4.41	-4.67	-4.93	-5.19	-0.10
-0.00	0.00	-0.26	-0.52	-0.78	-1.03	-1.29	-1.55	-1.81	-2.07	-2.33	-2.59	-0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.1. *Type T thermocouples—temperature (°C) as a function of thermoelectric voltage; reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
0.00	0.00	0.26	0.52	0.77	1.03	1.29	1.55	1.80	2.06	2.32	2.58	0.00
0.10	2.58	2.83	3.09	3.35	3.60	3.86	4.12	4.37	4.63	4.88	5.14	0.10
0.20	5.14	5.39	5.65	5.91	6.16	6.42	6.67	6.93	7.18	7.44	7.69	0.20
0.30	7.69	7.95	8.20	8.45	8.71	8.96	9.22	9.47	9.72	9.98	10.23	0.30
0.40	10.23	10.48	10.74	10.99	11.24	11.50	11.75	12.00	12.25	12.51	12.76	0.40
0.50	12.76	13.01	13.26	13.51	13.76	14.02	14.27	14.52	14.77	15.02	15.27	0.50
0.60	15.27	15.52	15.77	16.02	16.27	16.52	16.77	17.02	17.27	17.52	17.77	0.60
0.70	17.77	18.02	18.27	18.52	18.77	19.02	19.27	19.52	19.77	20.01	20.26	0.70
0.80	20.26	20.51	20.76	21.01	21.25	21.50	21.75	22.00	22.24	22.49	22.74	0.80
0.90	22.74	22.99	23.23	23.48	23.73	23.97	24.22	24.47	24.71	24.96	25.20	0.90
1.00	25.20	25.45	25.69	25.94	26.19	26.43	26.68	26.92	27.17	27.41	27.65	1.00
1.10	27.65	27.90	28.14	28.39	28.63	28.88	29.12	29.36	29.61	29.85	30.09	1.10
1.20	30.09	30.34	30.58	30.82	31.07	31.31	31.55	31.79	32.04	32.28	32.52	1.20
1.30	32.52	32.76	33.00	33.25	33.49	33.73	33.97	34.21	34.45	34.69	34.94	1.30
1.40	34.94	35.18	35.42	35.66	35.90	36.14	36.38	36.62	36.86	37.10	37.34	1.40
1.50	37.34	37.58	37.82	38.06	38.30	38.53	38.77	39.01	39.25	39.49	39.73	1.50
1.60	39.73	39.97	40.21	40.44	40.68	40.92	41.16	41.40	41.63	41.87	42.11	1.60
1.70	42.11	42.35	42.58	42.82	43.06	43.29	43.53	43.77	44.00	44.24	44.48	1.70
1.80	44.48	44.71	44.95	45.18	45.42	45.66	45.89	46.13	46.36	46.60	46.83	1.80
1.90	46.83	47.07	47.30	47.54	47.77	48.01	48.24	48.47	48.71	48.94	49.18	1.90
2.00	49.18	49.41	49.65	49.88	50.11	50.35	50.58	50.81	51.05	51.28	51.51	2.00
2.10	51.51	51.74	51.98	52.21	52.44	52.67	52.91	53.14	53.37	53.60	53.84	2.10
2.20	53.84	54.07	54.30	54.53	54.76	54.99	55.22	55.46	55.69	55.92	56.15	2.20
2.30	56.15	56.38	56.61	56.84	57.07	57.30	57.53	57.76	57.99	58.22	58.45	2.30
2.40	58.45	58.68	58.91	59.14	59.37	59.60	59.83	60.06	60.29	60.52	60.74	2.40
2.50	60.74	60.97	61.20	61.43	61.66	61.89	62.12	62.34	62.57	62.80	63.03	2.50
2.60	63.03	63.25	63.48	63.71	63.94	64.16	64.39	64.62	64.85	65.07	65.30	2.60
2.70	65.30	65.53	65.75	65.98	66.21	66.43	66.66	66.89	67.11	67.34	67.56	2.70
2.80	67.56	67.79	68.02	68.24	68.47	68.69	68.92	69.14	69.37	69.59	69.82	2.80
2.90	69.82	70.04	70.27	70.49	70.72	70.94	71.17	71.39	71.61	71.84	72.06	2.90
3.00	72.06	72.29	72.51	72.73	72.96	73.18	73.41	73.63	73.85	74.08	74.30	3.00
3.10	74.30	74.52	74.74	74.97	75.19	75.41	75.64	75.86	76.08	76.30	76.53	3.10
3.20	76.53	76.75	76.97	77.19	77.41	77.64	77.86	78.08	78.30	78.52	78.74	3.20
3.30	78.74	78.97	79.19	79.41	79.63	79.85	80.07	80.29	80.51	80.73	80.95	3.30
3.40	80.95	81.17	81.39	81.61	81.84	82.06	82.28	82.50	82.72	82.94	83.16	3.40
3.50	83.16	83.37	83.59	83.81	84.03	84.25	84.47	84.69	84.91	85.13	85.35	3.50
3.60	85.35	85.57	85.79	86.00	86.22	86.44	86.66	86.88	87.10	87.32	87.53	3.60
3.70	87.53	87.75	87.97	88.19	88.41	88.62	88.84	89.06	89.28	89.49	89.71	3.70
3.80	89.71	89.93	90.15	90.36	90.58	90.80	91.01	91.23	91.45	91.66	91.88	3.80
3.90	91.88	92.10	92.31	92.53	92.75	92.96	93.18	93.39	93.61	93.83	94.04	3.90
4.00	94.04	94.26	94.47	94.69	94.91	95.12	95.34	95.55	95.77	95.98	96.20	4.00
4.10	96.20	96.41	96.63	96.84	97.06	97.27	97.49	97.70	97.92	98.13	98.34	4.10
4.20	98.34	98.56	98.77	98.99	99.20	99.42	99.63	99.84	100.06	100.27	100.48	4.20
4.30	100.48	100.70	100.91	101.12	101.34	101.55	101.76	101.98	102.19	102.40	102.62	4.30
4.40	102.62	102.83	103.04	103.26	103.47	103.68	103.89	104.11	104.32	104.53	104.74	4.40
4.50	104.74	104.96	105.17	105.38	105.59	105.80	106.02	106.23	106.44	106.65	106.86	4.50
4.60	106.86	107.07	107.29	107.50	107.71	107.92	108.13	108.34	108.55	108.76	108.97	4.60
4.70	108.97	109.19	109.40	109.61	109.82	110.03	110.24	110.45	110.66	110.87	111.08	4.70
4.80	111.08	111.29	111.50	111.71	111.92	112.13	112.34	112.55	112.76	112.97	113.18	4.80
4.90	113.18	113.39	113.60	113.81	114.02	114.23	114.44	114.64	114.85	115.06	115.27	4.90
5.00	115.27	115.48	115.69	115.90	116.11	116.32	116.52	116.73	116.94	117.15	117.36	5.00
5.10	117.36	117.57	117.77	117.98	118.19	118.40	118.61	118.82	119.02	119.23	119.44	5.10
5.20	119.44	119.65	119.85	120.06	120.27	120.48	120.68	120.89	121.10	121.31	121.51	5.20
5.30	121.51	121.72	121.93	122.13	122.34	122.55	122.75	122.96	123.17	123.37	123.58	5.30
5.40	123.58	123.79	123.99	124.20	124.41	124.61	124.82	125.02	125.23	125.44	125.64	5.40
5.50	125.64	125.85	126.05	126.26	126.47	126.67	126.88	127.08	127.29	127.49	127.70	5.50
5.60	127.70	127.91	128.11	128.31	128.52	128.73	128.93	129.14	129.34	129.54	129.75	5.60
5.70	129.75	129.95	130.16	130.36	130.57	130.77	130.98	131.18	131.39	131.59	131.79	5.70
5.80	131.79	132.00	132.20	132.41	132.61	132.81	133.02	133.22	133.43	133.63	133.83	5.80
5.90	133.83	134.04	134.24	134.44	134.65	134.85	135.05	135.26	135.46	135.66	135.87	5.90
6.00	135.87	136.07	136.27	136.48	136.68	136.88	137.08	137.29	137.49	137.69	137.90	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.1. *Type T thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
6.00	135.87	136.07	136.27	136.48	136.68	136.88	137.08	137.29	137.49	137.69	137.90	6.00
6.10	137.90	138.10	138.30	138.50	138.70	138.91	139.11	139.31	139.51	139.72	139.92	6.10
6.20	139.92	140.12	140.32	140.52	140.73	140.93	141.13	141.33	141.53	141.73	141.94	6.20
6.30	141.94	142.14	142.34	142.54	142.74	142.94	143.14	143.34	143.55	143.75	143.95	6.30
6.40	143.95	144.15	144.35	144.55	144.75	144.95	145.15	145.35	145.55	145.75	145.95	6.40
6.50	145.95	146.15	146.36	146.56	146.76	146.96	147.16	147.36	147.56	147.76	147.96	6.50
6.60	147.96	148.16	148.36	148.56	148.76	148.96	149.15	149.35	149.55	149.75	149.95	6.60
6.70	149.95	150.15	150.35	150.55	150.75	150.95	151.15	151.35	151.55	151.75	151.94	6.70
6.80	151.94	152.14	152.34	152.54	152.74	152.94	153.14	153.34	153.53	153.73	153.93	6.80
6.90	153.93	154.13	154.33	154.53	154.72	154.92	155.12	155.32	155.52	155.72	155.91	6.90
7.00	155.91	156.11	156.31	156.51	156.70	156.90	157.10	157.30	157.50	157.69	157.89	7.00
7.10	157.89	158.09	158.28	158.48	158.68	158.88	159.07	159.27	159.47	159.67	159.86	7.10
7.20	159.86	160.06	160.26	160.45	160.65	160.85	161.04	161.24	161.44	161.63	161.83	7.20
7.30	161.83	162.03	162.22	162.42	162.62	162.81	163.01	163.20	163.40	163.60	163.79	7.30
7.40	163.79	163.99	164.18	164.38	164.58	164.77	164.97	165.16	165.36	165.56	165.75	7.40
7.50	165.75	165.95	166.14	166.34	166.53	166.73	166.92	167.12	167.31	167.51	167.70	7.50
7.60	167.70	167.90	168.09	168.29	168.48	168.68	168.87	169.07	169.26	169.46	169.65	7.60
7.70	169.65	169.85	170.04	170.24	170.43	170.63	170.82	171.02	171.21	171.40	171.60	7.70
7.80	171.60	171.79	171.99	172.18	172.37	172.57	172.76	172.96	173.15	173.34	173.54	7.80
7.90	173.54	173.73	173.93	174.12	174.31	174.51	174.70	174.89	175.09	175.28	175.47	7.90
8.00	175.47	175.67	175.86	176.05	176.25	176.44	176.63	176.83	177.02	177.21	177.41	8.00
8.10	177.41	177.60	177.79	177.98	178.18	178.37	178.56	178.76	178.95	179.14	179.33	8.10
8.20	179.33	179.53	179.72	179.91	180.10	180.29	180.49	180.68	180.87	181.06	181.26	8.20
8.30	181.26	181.45	181.64	181.83	182.02	182.22	182.41	182.60	182.79	182.98	183.17	8.30
8.40	183.17	183.37	183.56	183.75	183.94	184.13	184.32	184.52	184.71	184.90	185.09	8.40
8.50	185.09	185.28	185.47	185.66	185.85	186.05	186.24	186.43	186.62	186.81	187.00	8.50
8.60	187.00	187.19	187.38	187.57	187.76	187.95	188.14	188.33	188.53	188.72	188.91	8.60
8.70	188.91	189.10	189.29	189.48	189.67	189.86	190.05	190.24	190.43	190.62	190.81	8.70
8.80	190.81	191.00	191.19	191.38	191.57	191.76	191.95	192.14	192.33	192.52	192.71	8.80
8.90	192.71	192.90	193.09	193.28	193.47	193.65	193.84	194.03	194.22	194.41	194.60	8.90
9.00	194.60	194.79	194.98	195.17	195.36	195.55	195.74	195.93	196.11	196.30	196.49	9.00
9.10	196.49	196.68	196.87	197.06	197.25	197.44	197.62	197.81	198.00	198.19	198.38	9.10
9.20	198.38	198.57	198.76	198.94	199.13	199.32	199.51	199.70	199.89	200.07	200.26	9.20
9.30	200.26	200.45	200.64	200.83	201.01	201.20	201.39	201.58	201.77	201.95	202.14	9.30
9.40	202.14	202.33	202.52	202.70	202.89	203.08	203.27	203.45	203.64	203.83	204.02	9.40
9.50	204.02	204.20	204.39	204.58	204.77	204.95	205.14	205.33	205.51	205.70	205.89	9.50
9.60	205.89	206.08	206.26	206.45	206.64	206.82	207.01	207.20	207.38	207.57	207.76	9.60
9.70	207.76	207.94	208.13	208.32	208.50	208.69	208.88	209.06	209.25	209.43	209.62	9.70
9.80	209.62	209.81	209.99	210.18	210.37	210.55	210.74	210.92	211.11	211.30	211.48	9.80
9.90	211.48	211.67	211.85	212.04	212.23	212.41	212.60	212.78	212.97	213.15	213.34	9.90
10.00	213.34	213.52	213.71	213.90	214.08	214.27	214.45	214.64	214.82	215.01	215.19	10.00
10.10	215.19	215.38	215.56	215.75	215.93	216.12	216.30	216.49	216.67	216.86	217.04	10.10
10.20	217.04	217.23	217.41	217.60	217.78	217.97	218.15	218.34	218.52	218.71	218.89	10.20
10.30	218.89	219.08	219.26	219.44	219.63	219.81	220.00	220.18	220.37	220.55	220.73	10.30
10.40	220.73	220.92	221.10	221.29	221.47	221.65	221.84	222.02	222.21	222.39	222.57	10.40
10.50	222.57	222.76	222.94	223.13	223.31	223.49	223.68	223.86	224.04	224.23	224.41	10.50
10.60	224.41	224.59	224.78	224.96	225.15	225.33	225.51	225.70	225.88	226.06	226.24	10.60
10.70	226.24	226.43	226.61	226.79	226.98	227.16	227.34	227.53	227.71	227.89	228.08	10.70
10.80	228.08	228.26	228.44	228.62	228.81	228.99	229.17	229.35	229.54	229.72	229.90	10.80
10.90	229.90	230.08	230.27	230.45	230.63	230.81	231.00	231.18	231.36	231.54	231.73	10.90
11.00	231.73	231.91	232.09	232.27	232.45	232.64	232.82	233.00	233.18	233.37	233.55	11.00
11.10	233.55	233.73	233.91	234.09	234.27	234.46	234.64	234.82	235.00	235.18	235.36	11.10
11.20	235.36	235.55	235.73	235.91	236.09	236.27	236.45	236.64	236.82	237.00	237.18	11.20
11.30	237.18	237.36	237.54	237.72	237.90	238.09	238.27	238.45	238.63	238.81	238.99	11.30
11.40	238.99	239.17	239.35	239.53	239.71	239.90	240.08	240.26	240.44	240.62	240.80	11.40
11.50	240.80	240.98	241.16	241.34	241.52	241.70	241.88	242.06	242.24	242.42	242.60	11.50
11.60	242.60	242.79	242.97	243.15	243.33	243.51	243.69	243.87	244.05	244.23	244.41	11.60
11.70	244.41	244.59	244.77	244.95	245.13	245.31	245.49	245.67	245.85	246.03	246.21	11.70
11.80	246.21	246.39	246.57	246.75	246.93	247.11	247.29	247.46	247.64	247.82	248.00	11.80
11.90	248.00	248.18	248.36	248.54	248.72	248.90	249.08	249.26	249.44	249.62	249.80	11.90
12.00	249.80	249.98	250.16	250.34	250.51	250.69	250.87	251.05	251.23	251.41	251.59	12.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.1. Type T thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPITS 1968)												
12.00	249.80	249.98	250.16	250.34	250.51	250.69	250.87	251.05	251.23	251.41	251.59	12.00
12.10	251.59	251.77	251.95	252.13	252.30	252.48	252.66	252.84	253.02	253.20	253.38	12.10
12.20	253.38	253.56	253.73	253.91	254.09	254.27	254.45	254.63	254.81	254.98	255.16	12.20
12.30	255.16	255.34	255.52	255.70	255.88	256.05	256.23	256.41	256.59	256.77	256.94	12.30
12.40	256.94	257.12	257.30	257.48	257.66	257.84	258.01	258.19	258.37	258.55	258.72	12.40
12.50	258.72	258.90	259.08	259.26	259.44	259.61	259.79	259.97	260.15	260.32	260.50	12.50
12.60	260.50	260.68	260.86	261.03	261.21	261.39	261.57	261.74	261.92	262.10	262.28	12.60
12.70	262.28	262.45	262.63	262.81	262.99	263.16	263.34	263.52	263.69	263.87	264.05	12.70
12.80	264.05	264.23	264.40	264.58	264.76	264.93	265.11	265.29	265.46	265.64	265.82	12.80
12.90	265.82	265.99	266.17	266.35	266.52	266.70	266.88	267.05	267.23	267.41	267.58	12.90
13.00	267.58	267.76	267.94	268.11	268.29	268.47	268.64	268.82	269.00	269.17	269.35	13.00
13.10	269.35	269.53	269.70	269.88	270.05	270.23	270.41	270.58	270.76	270.93	271.11	13.10
13.20	271.11	271.29	271.46	271.64	271.81	271.99	272.17	272.34	272.52	272.69	272.87	13.20
13.30	272.87	273.05	273.22	273.40	273.57	273.75	273.92	274.10	274.28	274.45	274.63	13.30
13.40	274.63	274.80	274.98	275.15	275.33	275.50	275.68	275.85	276.03	276.21	276.38	13.40
13.50	276.38	276.56	276.73	276.91	277.08	277.26	277.43	277.61	277.78	277.96	278.13	13.50
13.60	278.13	278.31	278.48	278.66	278.83	279.01	279.18	279.36	279.53	279.71	279.88	13.60
13.70	279.88	280.06	280.23	280.41	280.58	280.76	280.93	281.10	281.28	281.45	281.63	13.70
13.80	281.63	281.80	281.98	282.15	282.33	282.50	282.68	282.85	283.02	283.20	283.37	13.80
13.90	283.37	283.55	283.72	283.90	284.07	284.24	284.42	284.59	284.77	284.94	285.12	13.90
14.00	285.12	285.29	285.46	285.64	285.81	285.99	286.16	286.33	286.51	286.68	286.86	14.00
14.10	286.86	287.03	287.20	287.38	287.55	287.72	287.90	288.07	288.25	288.42	288.59	14.10
14.20	288.59	288.77	288.94	289.11	289.29	289.46	289.63	289.81	289.98	290.15	290.33	14.20
14.30	290.33	290.50	290.67	290.85	291.02	291.19	291.37	291.54	291.71	291.89	292.06	14.30
14.40	292.06	292.23	292.41	292.58	292.75	292.93	293.10	293.27	293.45	293.62	293.79	14.40
14.50	293.79	293.96	294.14	294.31	294.48	294.66	294.83	295.00	295.17	295.35	295.52	14.50
14.60	295.52	295.69	295.87	296.04	296.21	296.38	296.56	296.73	296.90	297.07	297.25	14.60
14.70	297.25	297.42	297.59	297.76	297.94	298.11	298.28	298.45	298.63	298.80	298.97	14.70
14.80	298.97	299.14	299.31	299.49	299.66	299.83	300.00	300.18	300.35	300.52	300.69	14.80
14.90	300.69	300.86	301.04	301.21	301.38	301.55	301.72	301.90	302.07	302.24	302.41	14.90
15.00	302.41	302.58	302.76	302.93	303.10	303.27	303.44	303.61	303.79	303.96	304.13	15.00
15.10	304.13	304.30	304.47	304.64	304.82	304.99	305.16	305.33	305.50	305.67	305.84	15.10
15.20	305.84	306.02	306.19	306.36	306.53	306.70	306.87	307.04	307.21	307.39	307.56	15.20
15.30	307.56	307.73	307.90	308.07	308.24	308.41	308.58	308.76	308.93	309.10	309.27	15.30
15.40	309.27	309.44	309.61	309.78	309.95	310.12	310.29	310.46	310.64	310.81	310.98	15.40
15.50	310.98	311.15	311.32	311.49	311.66	311.83	312.00	312.17	312.34	312.51	312.68	15.50
15.60	312.68	312.85	313.03	313.20	313.37	313.54	313.71	313.88	314.05	314.22	314.39	15.60
15.70	314.39	314.56	314.73	314.90	315.07	315.24	315.41	315.58	315.75	315.92	316.09	15.70
15.80	316.09	316.26	316.43	316.60	316.77	316.94	317.11	317.28	317.45	317.62	317.79	15.80
15.90	317.79	317.96	318.13	318.30	318.47	318.64	318.81	318.98	319.15	319.32	319.49	15.90
16.00	319.49	319.66	319.83	320.00	320.17	320.34	320.51	320.68	320.85	321.02	321.19	16.00
16.10	321.19	321.36	321.53	321.70	321.87	322.03	322.20	322.37	322.54	322.71	322.88	16.10
16.20	322.88	323.05	323.22	323.39	323.56	323.73	323.90	324.07	324.24	324.41	324.57	16.20
16.30	324.57	324.74	324.91	325.08	325.25	325.42	325.59	325.76	325.93	326.10	326.26	16.30
16.40	326.26	326.43	326.60	326.77	326.94	327.11	327.28	327.45	327.62	327.78	327.95	16.40
16.50	327.95	328.12	328.29	328.46	328.63	328.80	328.97	329.13	329.30	329.47	329.64	16.50
16.60	329.64	329.81	329.98	330.15	330.31	330.48	330.65	330.82	330.99	331.16	331.32	16.60
16.70	331.32	331.49	331.66	331.83	332.00	332.17	332.33	332.50	332.67	332.84	333.01	16.70
16.80	333.01	333.18	333.34	333.51	333.68	333.85	334.02	334.18	334.35	334.52	334.69	16.80
16.90	334.69	334.86	335.02	335.19	335.36	335.53	335.70	335.86	336.03	336.20	336.37	16.90
17.00	336.37	336.53	336.70	336.87	337.04	337.21	337.37	337.54	337.71	337.88	338.04	17.00
17.10	338.04	338.21	338.38	338.55	338.71	338.88	339.05	339.22	339.38	339.55	339.72	17.10
17.20	339.72	339.89	340.05	340.22	340.39	340.55	340.72	340.89	341.06	341.22	341.39	17.20
17.30	341.39	341.56	341.73	341.89	342.06	342.23	342.39	342.56	342.73	342.90	343.06	17.30
17.40	343.06	343.23	343.40	343.56	343.73	343.90	344.06	344.23	344.40	344.56	344.73	17.40
17.50	344.73	344.90	345.07	345.23	345.40	345.57	345.73	345.90	346.07	346.23	346.40	17.50
17.60	346.40	346.57	346.73	346.90	347.07	347.23	347.40	347.56	347.73	347.90	348.06	17.60
17.70	348.06	348.23	348.40	348.56	348.73	348.90	349.06	349.23	349.40	349.56	349.73	17.70
17.80	349.73	349.89	350.06	350.23	350.39	350.56	350.73	350.89	351.06	351.22	351.39	17.80
17.90	351.39	351.56	351.72	351.89	352.05	352.22	352.39	352.55	352.72	352.88	353.05	17.90
18.00	353.05	353.22	353.38	353.55	353.71	353.88	354.04	354.21	354.38	354.54	354.71	18.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.1. *Type T thermocouples—temperature (°C) as a function of thermoelectric voltage, reference junctions at 0 °C—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES C (IPTS 1968)												
18.00	353.05	353.22	353.38	353.55	353.71	353.88	354.04	354.21	354.38	354.54	354.71	18.00
18.10	354.71	354.87	355.04	355.21	355.37	355.54	355.70	355.87	356.03	356.20	356.36	18.10
18.20	356.36	356.53	356.70	356.86	357.03	357.19	357.36	357.52	357.69	357.85	358.02	18.20
18.30	358.02	358.18	358.35	358.52	358.68	358.85	359.01	359.18	359.34	359.51	359.67	18.30
18.40	359.67	359.84	360.00	360.17	360.33	360.50	360.66	360.83	360.99	361.16	361.32	18.40
18.50	361.32	361.49	361.65	361.82	361.98	362.15	362.31	362.48	362.64	362.81	362.97	18.50
18.60	362.97	363.14	363.30	363.47	363.63	363.80	363.96	364.13	364.29	364.46	364.62	18.60
18.70	364.62	364.78	364.95	365.11	365.28	365.44	365.61	365.77	365.94	366.10	366.27	18.70
18.80	366.27	366.43	366.60	366.76	366.92	367.09	367.25	367.42	367.58	367.75	367.91	18.80
18.90	367.91	368.08	368.24	368.40	368.57	368.73	368.90	369.06	369.23	369.39	369.55	18.90
19.00	369.55	369.72	369.88	370.05	370.21	370.37	370.54	370.70	370.87	371.03	371.19	19.00
19.10	371.19	371.36	371.52	371.69	371.85	372.01	372.18	372.34	372.51	372.67	372.83	19.10
19.20	372.83	373.00	373.16	373.33	373.49	373.65	373.82	373.98	374.14	374.31	374.47	19.20
19.30	374.47	374.64	374.80	374.96	375.13	375.29	375.45	375.62	375.78	375.95	376.11	19.30
19.40	376.11	376.27	376.44	376.60	376.76	376.93	377.09	377.25	377.42	377.58	377.74	19.40
19.50	377.74	377.91	378.07	378.23	378.40	378.56	378.72	378.89	379.05	379.21	379.38	19.50
19.60	379.38	379.54	379.70	379.87	380.03	380.19	380.36	380.52	380.68	380.85	381.01	19.60
19.70	381.01	381.17	381.34	381.50	381.66	381.82	381.99	382.15	382.31	382.48	382.64	19.70
19.80	382.64	382.80	382.97	383.13	383.29	383.45	383.62	383.78	383.94	384.11	384.27	19.80
19.90	384.27	384.43	384.60	384.76	384.92	385.08	385.25	385.41	385.57	385.73	385.90	19.90
20.00	385.90	386.06	386.22	386.39	386.55	386.71	386.87	387.04	387.20	387.36	387.52	20.00
20.10	387.52	387.69	387.85	388.01	388.17	388.34	388.50	388.66	388.82	388.99	389.15	20.10
20.20	389.15	389.31	389.47	389.64	389.80	389.96	390.12	390.29	390.45	390.61	390.77	20.20
20.30	390.77	390.94	391.10	391.26	391.42	391.59	391.75	391.91	392.07	392.23	392.40	20.30
20.40	392.40	392.56	392.72	392.88	393.05	393.21	393.37	393.53	393.70	393.86	394.02	20.40
20.50	394.02	394.18	394.34	394.51	394.67	394.83	394.99	395.15	395.32	395.48	395.64	20.50
20.60	395.64	395.80	395.96	396.13	396.29	396.45	396.61	396.77	396.94	397.10	397.26	20.60
20.70	397.26	397.42	397.58	397.75	397.91	398.07	398.23	398.39	398.56	398.72	398.88	20.70
20.80	398.88	399.04	399.20	399.37	399.53	399.69	399.85					20.80
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.2. *Type T thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
-6.20	-423.90	-427.28	-431.00	-435.17	-440.05	-446.25						-6.20
-6.10	-398.96	-401.02	-403.15	-405.35	-407.64	-410.01	-412.50	-415.10	-417.85	-420.77	-423.90	-6.10
-6.00	-380.88	-382.53	-384.21	-385.92	-387.66	-389.43	-391.25	-393.11	-395.01	-396.96	-398.96	-6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.2. *Type T thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
-6.00	-380.88	-382.53	-384.21	-385.92	-387.66	-389.43	-391.25	-393.11	-395.01	-396.96	-398.96	-6.00
-5.90	-365.63	-367.07	-368.53	-370.00	-371.49	-373.01	-374.54	-376.09	-377.66	-379.26	-380.88	-5.90
-5.80	-351.99	-353.30	-354.62	-355.95	-357.29	-358.65	-360.02	-361.40	-362.80	-364.21	-365.63	-5.80
-5.70	-339.42	-340.64	-341.87	-343.10	-344.34	-345.59	-346.85	-348.12	-349.40	-350.69	-351.99	-5.70
-5.60	-327.67	-328.81	-329.96	-331.12	-332.28	-333.46	-334.63	-335.82	-337.01	-338.21	-339.42	-5.60
-5.50	-316.56	-317.64	-318.73	-319.83	-320.93	-322.04	-323.15	-324.27	-325.40	-326.53	-327.67	-5.50
-5.40	-305.98	-307.02	-308.06	-309.10	-310.15	-311.21	-312.27	-313.33	-314.40	-315.48	-316.56	-5.40
-5.30	-295.87	-296.86	-297.86	-298.86	-299.86	-300.87	-301.89	-302.90	-303.92	-304.95	-305.98	-5.30
-5.20	-286.16	-287.11	-288.07	-289.03	-290.00	-290.97	-291.94	-292.92	-293.90	-294.88	-295.87	-5.20
-5.10	-276.80	-277.72	-278.64	-279.57	-280.50	-281.44	-282.37	-283.31	-284.26	-285.21	-286.16	-5.10
-5.00	-267.75	-268.64	-269.54	-270.44	-271.34	-272.24	-273.14	-274.05	-274.97	-275.88	-276.80	-5.00
-4.90	-258.99	-259.85	-260.72	-261.59	-262.46	-263.34	-264.22	-265.10	-265.98	-266.86	-267.75	-4.90
-4.80	-250.48	-251.32	-252.16	-253.01	-253.85	-254.70	-255.56	-256.41	-257.27	-258.13	-258.99	-4.80
-4.70	-242.20	-243.02	-243.84	-244.66	-245.49	-246.31	-247.14	-247.97	-248.81	-249.64	-250.48	-4.70
-4.60	-234.13	-234.93	-235.73	-236.53	-237.34	-238.14	-238.95	-239.76	-240.57	-241.39	-242.20	-4.60
-4.50	-226.26	-227.04	-227.82	-228.61	-229.39	-230.18	-230.96	-231.75	-232.55	-233.34	-234.13	-4.50
-4.40	-218.57	-219.33	-220.10	-220.86	-221.63	-222.40	-223.17	-223.94	-224.71	-225.49	-226.26	-4.40
-4.30	-211.05	-211.80	-212.54	-213.29	-214.04	-214.79	-215.55	-216.30	-217.06	-217.81	-218.57	-4.30
-4.20	-203.69	-204.42	-205.15	-205.88	-206.61	-207.35	-208.09	-208.83	-209.57	-210.31	-211.05	-4.20
-4.10	-196.47	-197.18	-197.90	-198.62	-199.34	-200.06	-200.78	-201.51	-202.23	-202.96	-203.69	-4.10
-4.00	-189.39	-190.09	-190.79	-191.50	-192.20	-192.91	-193.62	-194.33	-195.04	-195.75	-196.47	-4.00
-3.90	-182.44	-183.13	-183.82	-184.51	-185.20	-185.90	-186.59	-187.29	-187.99	-188.69	-189.39	-3.90
-3.80	-175.61	-176.29	-176.97	-177.65	-178.33	-179.01	-179.69	-180.38	-181.06	-181.75	-182.44	-3.80
-3.70	-168.90	-169.56	-170.23	-170.90	-171.57	-172.24	-172.91	-173.58	-174.26	-174.93	-175.61	-3.70
-3.60	-162.29	-162.95	-163.60	-164.26	-164.92	-165.58	-166.24	-166.90	-167.57	-168.23	-168.90	-3.60
-3.50	-155.79	-156.43	-157.08	-157.73	-158.38	-159.03	-159.68	-160.33	-160.98	-161.64	-162.29	-3.50
-3.40	-149.38	-150.02	-150.66	-151.29	-151.93	-152.57	-153.21	-153.86	-154.50	-155.14	-155.79	-3.40
-3.30	-143.07	-143.69	-144.32	-144.95	-145.58	-146.21	-146.85	-147.48	-148.11	-148.75	-149.38	-3.30
-3.20	-136.84	-137.46	-138.08	-138.70	-139.32	-139.94	-140.57	-141.19	-141.82	-142.44	-143.07	-3.20
-3.10	-130.70	-131.31	-131.92	-132.53	-133.15	-133.76	-134.37	-134.99	-135.61	-136.22	-136.84	-3.10
-3.00	-124.63	-125.24	-125.84	-126.44	-127.05	-127.66	-128.26	-128.87	-129.48	-130.09	-130.70	-3.00
-2.90	-118.65	-119.24	-119.84	-120.43	-121.03	-121.63	-122.23	-122.83	-123.43	-124.03	-124.63	-2.90
-2.80	-112.73	-113.32	-113.91	-114.50	-115.09	-115.68	-116.27	-116.86	-117.46	-118.05	-118.65	-2.80
-2.70	-106.89	-107.47	-108.05	-108.63	-109.22	-109.80	-110.38	-110.97	-111.56	-112.14	-112.73	-2.70
-2.60	-101.11	-101.68	-102.26	-102.83	-103.41	-103.99	-104.57	-105.15	-105.73	-106.31	-106.89	-2.60
-2.50	-95.39	-95.96	-96.53	-97.10	-97.67	-98.24	-98.81	-99.39	-99.96	-100.53	-101.11	-2.50
-2.40	-89.74	-90.30	-90.87	-91.43	-92.00	-92.56	-93.13	-93.69	-94.26	-94.83	-95.39	-2.40
-2.30	-84.15	-84.71	-85.26	-85.82	-86.38	-86.94	-87.50	-88.06	-88.62	-89.18	-89.74	-2.30
-2.20	-78.61	-79.17	-79.72	-80.27	-80.82	-81.37	-81.93	-82.48	-83.04	-83.59	-84.15	-2.20
-2.10	-73.13	-73.68	-74.23	-74.77	-75.32	-75.87	-76.42	-76.96	-77.51	-78.06	-78.61	-2.10
-2.00	-67.71	-68.25	-68.79	-69.33	-69.87	-70.41	-70.96	-71.50	-72.04	-72.59	-73.13	-2.00
-1.90	-62.33	-62.87	-63.40	-63.94	-64.48	-65.01	-65.55	-66.09	-66.63	-67.17	-67.71	-1.90
-1.80	-57.01	-57.54	-58.07	-58.60	-59.13	-59.66	-60.20	-60.73	-61.26	-61.80	-62.33	-1.80
-1.70	-51.73	-52.25	-52.78	-53.31	-53.83	-54.36	-54.89	-55.42	-55.95	-56.48	-57.01	-1.70
-1.60	-46.49	-47.01	-47.54	-48.06	-48.58	-49.10	-49.63	-50.15	-50.68	-51.20	-51.73	-1.60
-1.50	-41.30	-41.82	-42.34	-42.86	-43.37	-43.89	-44.41	-44.93	-45.45	-45.97	-46.49	-1.50
-1.40	-36.16	-36.67	-37.18	-37.70	-38.21	-38.73	-39.24	-39.76	-40.27	-40.79	-41.30	-1.40
-1.30	-31.05	-31.56	-32.07	-32.58	-33.09	-33.60	-34.11	-34.62	-35.13	-35.65	-36.16	-1.30
-1.20	-25.99	-26.49	-27.00	-27.50	-28.01	-28.52	-29.02	-29.53	-30.04	-30.55	-31.05	-1.20
-1.10	-20.96	-21.47	-21.97	-22.47	-22.97	-23.47	-23.97	-24.48	-24.98	-25.49	-25.99	-1.10
-1.00	-15.98	-16.48	-16.97	-17.47	-17.97	-18.47	-18.97	-19.46	-19.96	-20.46	-20.96	-1.00
-0.90	-11.03	-11.52	-12.02	-12.51	-13.00	-13.50	-13.99	-14.49	-14.99	-15.48	-15.98	-0.90
-0.80	-6.12	-6.61	-7.10	-7.59	-8.08	-8.57	-9.06	-9.55	-10.04	-10.54	-11.03	-0.80
-0.70	-1.24	-1.73	-2.21	-2.70	-3.19	-3.67	-4.16	-4.65	-5.14	-5.63	-6.12	-0.70
-0.60	3.60	3.12	2.64	2.15	1.67	1.19	0.70	0.22	-0.27	-0.75	-1.24	-0.60
-0.50	8.41	7.93	7.45	6.97	6.49	6.01	5.53	5.05	4.57	4.09	3.60	-0.50
-0.40	13.19	12.71	12.24	11.76	11.28	10.81	10.33	9.85	9.37	8.89	8.41	-0.40
-0.30	17.94	17.46	16.99	16.52	16.04	15.57	15.09	14.62	14.14	13.67	13.19	-0.30
-0.20	22.65	22.18	21.71	21.24	20.77	20.30	19.83	19.35	18.88	18.41	17.94	-0.20
-0.10	27.34	26.87	26.40	25.94	25.47	25.00	24.53	24.06	23.59	23.12	22.65	-0.10
-0.00	32.00	31.54	31.07	30.60	30.14	29.67	29.21	28.74	28.27	27.81	27.34	-0.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.2. *Type T thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
0.00	32.00	32.46	32.93	33.39	33.86	34.32	34.78	35.25	35.71	36.17	36.64	0.00
0.10	36.64	37.10	37.56	38.02	38.48	38.95	39.41	39.87	40.33	40.79	41.25	0.10
0.20	41.25	41.71	42.17	42.63	43.09	43.55	44.01	44.47	44.93	45.39	45.84	0.20
0.30	45.84	46.30	46.76	47.22	47.67	48.13	48.59	49.05	49.50	49.96	50.41	0.30
0.40	50.41	50.87	51.33	51.78	52.24	52.69	53.15	53.60	54.06	54.51	54.96	0.40
0.50	54.96	55.42	55.87	56.32	56.78	57.23	57.68	58.13	58.59	59.04	59.49	0.50
0.60	59.49	59.94	60.39	60.84	61.29	61.74	62.19	62.64	63.09	63.54	63.99	0.60
0.70	63.99	64.44	64.89	65.34	65.79	66.24	66.68	67.13	67.58	68.03	68.47	0.70
0.80	68.47	68.92	69.37	69.81	70.26	70.70	71.15	71.60	72.04	72.49	72.93	0.80
0.90	72.93	73.37	73.82	74.26	74.71	75.15	75.59	76.04	76.48	76.92	77.37	0.90
1.00	77.37	77.81	78.25	78.69	79.13	79.57	80.02	80.46	80.90	81.34	81.78	1.00
1.10	81.78	82.22	82.66	83.10	83.54	83.98	84.41	84.85	85.29	85.73	86.17	1.10
1.20	86.17	86.61	87.04	87.48	87.92	88.36	88.79	89.23	89.66	90.10	90.54	1.20
1.30	90.54	90.97	91.41	91.84	92.28	92.71	93.15	93.58	94.02	94.45	94.88	1.30
1.40	94.88	95.32	95.75	96.18	96.62	97.05	97.48	97.91	98.34	98.78	99.21	1.40
1.50	99.21	99.64	100.07	100.50	100.93	101.36	101.79	102.22	102.65	103.08	103.51	1.50
1.60	103.51	103.94	104.37	104.80	105.23	105.66	106.08	106.51	106.94	107.37	107.79	1.60
1.70	107.79	108.22	108.65	109.07	109.50	109.93	110.35	110.78	111.21	111.63	112.06	1.70
1.80	112.06	112.48	112.91	113.33	113.75	114.18	114.60	115.03	115.45	115.87	116.30	1.80
1.90	116.30	116.72	117.14	117.57	117.99	118.41	118.83	119.25	119.68	120.10	120.52	1.90
2.00	120.52	120.94	121.36	121.78	122.20	122.62	123.04	123.46	123.88	124.30	124.72	2.00
2.10	124.72	125.14	125.56	125.98	126.40	126.81	127.23	127.65	128.07	128.49	128.90	2.10
2.20	128.90	129.32	129.74	130.15	130.57	130.99	131.40	131.82	132.24	132.65	133.07	2.20
2.30	133.07	133.48	133.90	134.31	134.73	135.14	135.56	135.97	136.39	136.80	137.21	2.30
2.40	137.21	137.63	138.04	138.45	138.87	139.28	139.69	140.10	140.52	140.93	141.34	2.40
2.50	141.34	141.75	142.16	142.57	142.99	143.40	143.81	144.22	144.63	145.04	145.45	2.50
2.60	145.45	145.86	146.27	146.68	147.09	147.50	147.91	148.31	148.72	149.13	149.54	2.60
2.70	149.54	149.95	150.36	150.76	151.17	151.58	151.99	152.39	152.80	153.21	153.61	2.70
2.80	153.61	154.02	154.43	154.83	155.24	155.65	156.05	156.46	156.86	157.27	157.67	2.80
2.90	157.67	158.08	158.48	158.89	159.29	159.69	160.10	160.50	160.91	161.31	161.71	2.90
3.00	161.71	162.12	162.52	162.92	163.32	163.73	164.13	164.53	164.93	165.34	165.74	3.00
3.10	165.74	166.14	166.54	166.94	167.34	167.74	168.14	168.54	168.95	169.35	169.75	3.10
3.20	169.75	170.15	170.55	170.95	171.34	171.74	172.14	172.54	172.94	173.34	173.74	3.20
3.30	173.74	174.14	174.54	174.93	175.33	175.73	176.13	176.52	176.92	177.32	177.72	3.30
3.40	177.72	178.11	178.51	178.91	179.30	179.70	180.10	180.49	180.89	181.28	181.68	3.40
3.50	181.68	182.07	182.47	182.87	183.26	183.65	184.05	184.44	184.84	185.23	185.63	3.50
3.60	185.63	186.02	186.41	186.81	187.20	187.60	187.99	188.38	188.78	189.17	189.56	3.60
3.70	189.56	189.95	190.35	190.74	191.13	191.52	191.91	192.31	192.70	193.09	193.48	3.70
3.80	193.48	193.87	194.26	194.65	195.04	195.43	195.82	196.21	196.61	197.00	197.39	3.80
3.90	197.39	197.77	198.16	198.55	198.94	199.33	199.72	200.11	200.50	200.89	201.28	3.90
4.00	201.28	201.67	202.05	202.44	202.83	203.22	203.61	203.99	204.38	204.77	205.15	4.00
4.10	205.15	205.54	205.93	206.32	206.70	207.09	207.48	207.86	208.25	208.63	209.02	4.10
4.20	209.02	209.41	209.79	210.18	210.56	210.95	211.33	211.72	212.10	212.49	212.87	4.20
4.30	212.87	213.26	213.64	214.02	214.41	214.79	215.18	215.56	215.94	216.33	216.71	4.30
4.40	216.71	217.09	217.48	217.86	218.24	218.63	219.01	219.39	219.77	220.16	220.54	4.40
4.50	220.54	220.92	221.30	221.68	222.06	222.45	222.83	223.21	223.59	223.97	224.35	4.50
4.60	224.35	224.73	225.11	225.49	225.87	226.25	226.63	227.01	227.39	227.77	228.15	4.60
4.70	228.15	228.53	228.91	229.29	229.67	230.05	230.43	230.81	231.19	231.57	231.94	4.70
4.80	231.94	232.32	232.70	233.08	233.46	233.83	234.21	234.59	234.97	235.35	235.72	4.80
4.90	235.72	236.10	236.48	236.85	237.23	237.61	237.98	238.36	238.74	239.11	239.49	4.90
5.00	239.49	239.87	240.24	240.62	240.99	241.37	241.74	242.12	242.50	242.87	243.25	5.00
5.10	243.25	243.62	243.99	244.37	244.74	245.12	245.49	245.87	246.24	246.62	246.99	5.10
5.20	246.99	247.36	247.74	248.11	248.48	248.86	249.23	249.60	249.98	250.35	250.72	5.20
5.30	250.72	251.10	251.47	251.84	252.21	252.59	252.96	253.33	253.70	254.07	254.45	5.30
5.40	254.45	254.82	255.19	255.56	255.93	256.30	256.67	257.04	257.42	257.79	258.16	5.40
5.50	258.16	258.53	258.90	259.27	259.64	260.01	260.38	260.75	261.12	261.49	261.86	5.50
5.60	261.86	262.23	262.60	262.97	263.34	263.71	264.08	264.44	264.81	265.18	265.55	5.60
5.70	265.55	265.92	266.29	266.65	267.02	267.39	267.76	268.13	268.49	268.86	269.23	5.70
5.80	269.23	269.60	269.96	270.33	270.70	271.07	271.43	271.80	272.17	272.53	272.90	5.80
5.90	272.90	273.27	273.63	274.00	274.37	274.73	275.10	275.46	275.83	276.20	276.56	5.90
6.00	276.56	276.93	277.29	277.66	278.02	278.39	278.75	279.12	279.48	279.85	280.21	6.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.2. *Type T thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
6.00	276.56	276.93	277.29	277.66	278.02	278.39	278.75	279.12	279.48	279.85	280.21	6.00
6.10	280.21	280.58	280.94	281.30	281.67	282.03	282.40	282.76	283.12	283.49	283.85	6.10
6.20	283.85	284.22	284.58	284.94	285.31	285.67	286.03	286.40	286.76	287.12	287.48	6.20
6.30	287.48	287.85	288.21	288.57	288.93	289.30	289.66	290.02	290.38	290.74	291.11	6.30
6.40	291.11	291.47	291.83	292.19	292.55	292.91	293.27	293.64	294.00	294.36	294.72	6.40
6.50	294.72	295.08	295.44	295.80	296.16	296.52	296.88	297.24	297.60	297.96	298.32	6.50
6.60	298.32	298.68	299.04	299.40	299.76	300.12	300.48	300.84	301.20	301.56	301.92	6.60
6.70	301.92	302.27	302.63	302.99	303.35	303.71	304.07	304.43	304.78	305.14	305.50	6.70
6.80	305.50	305.86	306.22	306.57	306.93	307.29	307.65	308.00	308.36	308.72	309.08	6.80
6.90	309.08	309.43	309.79	310.15	310.50	310.86	311.22	311.57	311.93	312.29	312.64	6.90
7.00	312.64	313.00	313.36	313.71	314.07	314.42	314.78	315.14	315.49	315.85	316.20	7.00
7.10	316.20	316.56	316.91	317.27	317.62	317.98	318.33	318.69	319.04	319.40	319.75	7.10
7.20	319.75	320.11	320.46	320.82	321.17	321.52	321.88	322.23	322.59	322.94	323.29	7.20
7.30	323.29	323.65	324.00	324.35	324.71	325.06	325.41	325.77	326.12	326.47	326.83	7.30
7.40	326.83	327.18	327.53	327.88	328.24	328.59	328.94	329.29	329.65	330.00	330.35	7.40
7.50	330.35	330.70	331.06	331.41	331.76	332.11	332.46	332.81	333.17	333.52	333.87	7.50
7.60	333.87	334.22	334.57	334.92	335.27	335.62	335.97	336.32	336.68	337.03	337.38	7.60
7.70	337.38	337.73	338.08	338.43	338.78	339.13	339.48	339.83	340.18	340.53	340.88	7.70
7.80	340.88	341.23	341.58	341.93	342.27	342.62	342.97	343.32	343.67	344.02	344.37	7.80
7.90	344.37	344.72	345.07	345.42	345.76	346.11	346.46	346.81	347.16	347.51	347.85	7.90
8.00	347.85	348.20	348.55	348.90	349.25	349.59	349.94	350.29	350.64	350.98	351.33	8.00
8.10	351.33	351.68	352.02	352.37	352.72	353.07	353.41	353.76	354.11	354.45	354.80	8.10
8.20	354.80	355.15	355.49	355.84	356.18	356.53	356.88	357.22	357.57	357.91	358.26	8.20
8.30	358.26	358.61	358.95	359.30	359.64	359.99	360.33	360.68	361.02	361.37	361.71	8.30
8.40	361.71	362.06	362.40	362.75	363.09	363.44	363.78	364.13	364.47	364.82	365.16	8.40
8.50	365.16	365.50	365.85	366.19	366.54	366.88	367.22	367.57	367.91	368.26	368.60	8.50
8.60	368.60	368.94	369.29	369.63	369.97	370.32	370.66	371.00	371.35	371.69	372.03	8.60
8.70	372.03	372.37	372.72	373.06	373.40	373.74	374.09	374.43	374.77	375.11	375.46	8.70
8.80	375.46	375.80	376.14	376.48	376.82	377.17	377.51	377.85	378.19	378.53	378.87	8.80
8.90	378.87	379.21	379.56	379.90	380.24	380.58	380.92	381.26	381.60	381.94	382.28	8.90
9.00	382.28	382.62	382.96	383.30	383.65	383.99	384.33	384.67	385.01	385.35	385.69	9.00
9.10	385.69	386.03	386.37	386.71	387.05	387.39	387.72	388.06	388.40	388.74	389.08	9.10
9.20	389.08	389.42	389.76	390.10	390.44	390.78	391.12	391.46	391.79	392.13	392.47	9.20
9.30	392.47	392.81	393.15	393.49	393.83	394.16	394.50	394.84	395.18	395.52	395.85	9.30
9.40	395.85	396.19	396.53	396.87	397.21	397.54	397.88	398.22	398.56	398.89	399.23	9.40
9.50	399.23	399.57	399.90	400.24	400.58	400.92	401.25	401.59	401.93	402.26	402.60	9.50
9.60	402.60	402.94	403.27	403.61	403.95	404.28	404.62	404.95	405.29	405.63	405.96	9.60
9.70	405.96	406.30	406.63	406.97	407.31	407.64	407.98	408.31	408.65	408.98	409.32	9.70
9.80	409.32	409.65	409.99	410.32	410.66	410.99	411.33	411.66	412.00	412.33	412.67	9.80
9.90	412.67	413.00	413.34	413.67	414.01	414.34	414.67	415.01	415.34	415.68	416.01	9.90
10.00	416.01	416.34	416.68	417.01	417.35	417.68	418.01	418.35	418.68	419.01	419.35	10.00
10.10	419.35	419.68	420.01	420.35	420.68	421.01	421.35	421.68	422.01	422.35	422.68	10.10
10.20	422.68	423.01	423.34	423.68	424.01	424.34	424.67	425.01	425.34	425.67	426.00	10.20
10.30	426.00	426.34	426.67	427.00	427.33	427.66	427.99	428.33	428.66	428.99	429.32	10.30
10.40	429.32	429.65	429.98	430.32	430.65	430.98	431.31	431.64	431.97	432.30	432.63	10.40
10.50	432.63	432.96	433.30	433.63	433.96	434.29	434.62	434.95	435.28	435.61	435.94	10.50
10.60	435.94	436.27	436.60	436.93	437.26	437.59	437.92	438.25	438.58	438.91	439.24	10.60
10.70	439.24	439.57	439.90	440.23	440.56	440.89	441.22	441.55	441.88	442.21	442.54	10.70
10.80	442.54	442.86	443.19	443.52	443.85	444.18	444.51	444.84	445.17	445.50	445.82	10.80
10.90	445.82	446.15	446.48	446.81	447.14	447.47	447.79	448.12	448.45	448.78	449.11	10.90
11.00	449.11	449.44	449.76	450.09	450.42	450.75	451.07	451.40	451.73	452.06	452.38	11.00
11.10	452.38	452.71	453.04	453.37	453.69	454.02	454.35	454.68	455.00	455.33	455.66	11.10
11.20	455.66	455.98	456.31	456.64	456.96	457.29	457.62	457.94	458.27	458.60	458.92	11.20
11.30	458.92	459.25	459.58	459.90	460.23	460.55	460.88	461.21	461.53	461.86	462.18	11.30
11.40	462.18	462.51	462.83	463.16	463.49	463.81	464.14	464.46	464.79	465.11	465.44	11.40
11.50	465.44	465.76	466.09	466.41	466.74	467.06	467.39	467.71	468.04	468.36	468.69	11.50
11.60	468.69	469.01	469.34	469.66	469.99	470.31	470.64	470.96	471.28	471.61	471.93	11.60
11.70	471.93	472.26	472.58	472.91	473.23	473.55	473.88	474.20	474.52	474.85	475.17	11.70
11.80	475.17	475.50	475.82	476.14	476.47	476.79	477.11	477.44	477.76	478.08	478.41	11.80
11.90	478.41	478.73	479.05	479.38	479.70	480.02	480.34	480.67	480.99	481.31	481.64	11.90
12.00	481.64	481.96	482.28	482.60	482.93	483.25	483.57	483.89	484.21	484.54	484.86	12.00

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
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TABLE A8.2.2. Type T thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
12.00	481.64	481.96	482.28	482.60	482.93	483.25	483.57	483.89	484.21	484.54	484.86	12.00
12.10	484.86	485.18	485.50	485.83	486.15	486.47	486.79	487.11	487.43	487.76	488.08	12.10
12.20	488.08	488.40	488.72	489.04	489.36	489.69	490.01	490.33	490.65	490.97	491.29	12.20
12.30	491.29	491.61	491.93	492.26	492.58	492.90	493.22	493.54	493.86	494.18	494.50	12.30
12.40	494.50	494.82	495.14	495.46	495.78	496.10	496.42	496.74	497.06	497.38	497.70	12.40
12.50	497.70	498.02	498.34	498.66	498.98	499.30	499.62	499.94	500.26	500.58	500.90	12.50
12.60	500.90	501.22	501.54	501.86	502.18	502.50	502.82	503.14	503.46	503.78	504.10	12.60
12.70	504.10	504.42	504.74	505.06	505.37	505.69	506.01	506.33	506.65	506.97	507.29	12.70
12.80	507.29	507.61	507.92	508.24	508.56	508.88	509.20	509.52	509.84	510.15	510.47	12.80
12.90	510.47	510.79	511.11	511.43	511.74	512.06	512.38	512.70	513.02	513.33	513.65	12.90
13.00	513.65	513.97	514.29	514.61	514.92	515.24	515.56	515.88	516.19	516.51	516.83	13.00
13.10	516.83	517.15	517.46	517.78	518.10	518.41	518.73	519.05	519.37	519.68	520.00	13.10
13.20	520.00	520.32	520.63	520.95	521.27	521.58	521.90	522.22	522.53	522.85	523.17	13.20
13.30	523.17	523.48	523.80	524.11	524.43	524.75	525.06	525.38	525.70	526.01	526.33	13.30
13.40	526.33	526.64	526.96	527.28	527.59	527.91	528.22	528.54	528.85	529.17	529.49	13.40
13.50	529.49	529.80	530.12	530.43	530.75	531.06	531.38	531.69	532.01	532.32	532.64	13.50
13.60	532.64	532.95	533.27	533.58	533.90	534.21	534.53	534.84	535.16	535.47	535.79	13.60
13.70	535.79	536.10	536.42	536.73	537.05	537.36	537.67	537.99	538.30	538.62	538.93	13.70
13.80	538.93	539.25	539.56	539.87	540.19	540.50	540.82	541.13	541.44	541.76	542.07	13.80
13.90	542.07	542.39	542.70	543.01	543.33	543.64	543.95	544.27	544.58	544.89	545.21	13.90
14.00	545.21	545.52	545.83	546.15	546.46	546.77	547.09	547.40	547.71	548.03	548.34	14.00
14.10	548.34	548.65	548.96	549.28	549.59	549.90	550.22	550.53	550.84	551.15	551.47	14.10
14.20	551.47	551.78	552.09	552.40	552.72	553.03	553.34	553.65	553.97	554.28	554.59	14.20
14.30	554.59	554.90	555.21	555.53	555.84	556.15	556.46	556.77	557.09	557.40	557.71	14.30
14.40	557.71	558.02	558.33	558.64	558.96	559.27	559.58	559.89	560.20	560.51	560.82	14.40
14.50	560.82	561.14	561.45	561.76	562.07	562.38	562.69	563.00	563.31	563.62	563.94	14.50
14.60	563.94	564.25	564.56	564.87	565.18	565.49	565.80	566.11	566.42	566.73	567.04	14.60
14.70	567.04	567.35	567.66	567.97	568.28	568.59	568.91	569.22	569.53	569.84	570.15	14.70
14.80	570.15	570.46	570.77	571.08	571.39	571.70	572.01	572.32	572.63	572.94	573.25	14.80
14.90	573.25	573.55	573.86	574.17	574.48	574.79	575.10	575.41	575.72	576.03	576.34	14.90
15.00	576.34	576.65	576.96	577.27	577.58	577.89	578.20	578.50	578.81	579.12	579.43	15.00
15.10	579.43	579.74	580.05	580.36	580.67	580.98	581.28	581.59	581.90	582.21	582.52	15.10
15.20	582.52	582.83	583.14	583.44	583.75	584.06	584.37	584.68	584.99	585.29	585.60	15.20
15.30	585.60	585.91	586.22	586.53	586.84	587.14	587.45	587.76	588.07	588.38	588.68	15.30
15.40	588.68	588.99	589.30	589.61	589.91	590.22	590.53	590.84	591.14	591.45	591.76	15.40
15.50	591.76	592.07	592.37	592.68	592.99	593.30	593.60	593.91	594.22	594.52	594.83	15.50
15.60	594.83	595.14	595.45	595.75	596.06	596.37	596.67	596.98	597.29	597.59	597.90	15.60
15.70	597.90	598.21	598.51	598.82	599.13	599.43	599.74	600.05	600.35	600.66	600.96	15.70
15.80	600.96	601.27	601.58	601.88	602.19	602.50	602.80	603.11	603.41	603.72	604.03	15.80
15.90	604.03	604.33	604.64	604.94	605.25	605.55	605.86	606.17	606.47	606.78	607.08	15.90
16.00	607.08	607.39	607.69	608.00	608.31	608.61	608.92	609.22	609.53	609.83	610.14	16.00
16.10	610.14	610.44	610.75	611.05	611.36	611.66	611.97	612.27	612.58	612.88	613.19	16.10
16.20	613.19	613.49	613.80	614.10	614.41	614.71	615.02	615.32	615.62	615.93	616.23	16.20
16.30	616.23	616.54	616.84	617.15	617.45	617.76	618.06	618.36	618.67	618.97	619.28	16.30
16.40	619.28	619.58	619.88	620.19	620.49	620.80	621.10	621.40	621.71	622.01	622.32	16.40
16.50	622.32	622.62	622.92	623.23	623.53	623.83	624.14	624.44	624.74	625.05	625.35	16.50
16.60	625.35	625.66	625.96	626.26	626.56	626.87	627.17	627.47	627.78	628.08	628.38	16.60
16.70	628.38	628.69	628.99	629.29	629.60	629.90	630.20	630.50	630.81	631.11	631.41	16.70
16.80	631.41	631.72	632.02	632.32	632.62	632.93	633.23	633.53	633.83	634.14	634.44	16.80
16.90	634.44	634.74	635.04	635.34	635.65	635.95	636.25	636.55	636.86	637.16	637.46	16.90
17.00	637.46	637.76	638.06	638.37	638.67	638.97	639.27	639.57	639.87	640.18	640.48	17.00
17.10	640.48	640.78	641.08	641.38	641.68	641.99	642.29	642.59	642.89	643.19	643.49	17.10
17.20	643.49	643.79	644.10	644.40	644.70	645.00	645.30	645.60	645.90	646.20	646.50	17.20
17.30	646.50	646.80	647.11	647.41	647.71	648.01	648.31	648.61	648.91	649.21	649.51	17.30
17.40	649.51	649.81	650.11	650.41	650.71	651.01	651.32	651.62	651.92	652.22	652.52	17.40
17.50	652.52	652.82	653.12	653.42	653.72	654.02	654.32	654.62	654.92	655.22	655.52	17.50
17.60	655.52	655.82	656.12	656.42	656.72	657.02	657.32	657.62	657.92	658.22	658.52	17.60
17.70	658.52	658.82	659.11	659.41	659.71	660.01	660.31	660.61	660.91	661.21	661.51	17.70
17.80	661.51	661.81	662.11	662.41	662.71	663.01	663.31	663.61	663.91	664.21	664.51	17.80
17.90	664.51	664.81	665.10	665.40	665.70	666.00	666.29	666.59	666.89	667.19	667.49	17.90
18.00	667.49	667.79	668.09	668.39	668.68	668.98	669.28	669.58	669.88	670.18	670.47	18.00
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.2. *Type T thermocouples—temperature (°F) as a function of thermoelectric voltage, reference junctions at 32 °F—Continued*

mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV
TEMPERATURES IN DEGREES F												
18.00	667.49	667.79	668.09	668.39	668.68	668.98	669.28	669.58	669.88	670.18	670.47	18.00
18.10	670.47	670.77	671.07	671.37	671.67	671.97	672.26	672.56	672.86	673.16	673.46	18.10
18.20	673.46	673.75	674.05	674.35	674.65	674.95	675.24	675.54	675.84	676.14	676.43	18.20
18.30	676.43	676.73	677.03	677.33	677.62	677.92	678.22	678.52	678.81	679.11	679.41	18.30
18.40	679.41	679.71	680.00	680.30	680.60	680.90	681.19	681.49	681.79	682.08	682.38	18.40
18.50	682.38	682.68	682.98	683.27	683.57	683.87	684.16	684.46	684.76	685.05	685.35	18.50
18.60	685.35	685.65	685.94	686.24	686.54	686.83	687.13	687.43	687.72	688.02	688.32	18.60
18.70	688.32	688.61	688.91	689.21	689.50	689.80	690.09	690.39	690.69	690.98	691.28	18.70
18.80	691.28	691.58	691.87	692.17	692.46	692.76	693.06	693.35	693.65	693.94	694.24	18.80
18.90	694.24	694.54	694.83	695.13	695.42	695.72	696.01	696.31	696.61	696.90	697.20	18.90
19.00	697.20	697.49	697.79	698.08	698.38	698.67	698.97	699.26	699.56	699.85	700.15	19.00
19.10	700.15	700.45	700.74	701.04	701.33	701.63	701.92	702.22	702.51	702.81	703.10	19.10
19.20	703.10	703.40	703.69	703.99	704.28	704.58	704.87	705.17	705.46	705.76	706.05	19.20
19.30	706.05	706.34	706.64	706.93	707.23	707.52	707.82	708.11	708.41	708.70	709.00	19.30
19.40	709.00	709.29	709.58	709.88	710.17	710.47	710.76	711.06	711.35	711.64	711.94	19.40
19.50	711.94	712.23	712.53	712.82	713.12	713.41	713.70	714.00	714.29	714.59	714.88	19.50
19.60	714.88	715.17	715.47	715.76	716.05	716.35	716.64	716.94	717.23	717.52	717.82	19.60
19.70	717.82	718.11	718.40	718.70	718.99	719.28	719.58	719.87	720.17	720.46	720.75	19.70
19.80	720.75	721.05	721.34	721.63	721.93	722.22	722.51	722.81	723.10	723.39	723.68	19.80
19.90	723.68	723.98	724.27	724.56	724.86	725.15	725.44	725.74	726.03	726.32	726.62	19.90
20.00	726.62	726.91	727.20	727.49	727.79	728.08	728.37	728.67	728.96	729.25	729.54	20.00
20.10	729.54	729.84	730.13	730.42	730.71	731.01	731.30	731.59	731.88	732.18	732.47	20.10
20.20	732.47	732.76	733.05	733.35	733.64	733.93	734.22	734.52	734.81	735.10	735.39	20.20
20.30	735.39	735.69	735.98	736.27	736.56	736.85	737.15	737.44	737.73	738.02	738.31	20.30
20.40	738.31	738.61	738.90	739.19	739.48	739.78	740.07	740.36	740.65	740.94	741.23	20.40
20.50	741.23	741.53	741.82	742.11	742.40	742.69	742.99	743.28	743.57	743.86	744.15	20.50
20.60	744.15	744.44	744.74	745.03	745.32	745.61	745.90	746.19	746.49	746.78	747.07	20.60
20.70	747.07	747.36	747.65	747.94	748.24	748.53	748.82	749.11	749.40	749.69	749.98	20.70
20.80	749.98	750.28	750.57	750.86	751.15	751.44	751.73					20.80
mV	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	mV

TABLE A8.2.3. *Type T thermocouples—quadratic, cubic, and quartic approximations to the data as a function of voltage in selected temperature ranges (°C). The expansion is of the form $T = a_0 + a_1E + a_2E^2 + a_3E^3 + a_4E^4$ where E is in microvolts and T is in degrees Celsius*

Temperature Range (°C)	a ₀		a ₁		a ₂		a ₃		a ₄		Error Range (°C)
	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Argument	Exp.	Error-Approx.
I. Quartic Equation											
-270 to 0	4.3553379	-3	-2.0325426	-5	-5.4720813	-9	-5.0865527	-13	-8 to 6
-200 to 0	2.3837090	-2	-2.9878839	-6	-7.1945810	-10	-1.0041943	-13	-.3 to .3
-200 to 400	2.6792411	-2	-1.0370271	-6	6.1330327	-11	-1.3988385	-15	-6 to 5
0 to 400	2.5661297	-2	-6.1954869	-7	2.2181644	-11	-3.5500900	-16	-.15 to .17
II. Cubic Equation											
-270 to 0	3.8740225	-2	6.9418930	-6	1.1736679	-9	.....	..	-12 to 7
-200 to 0	2.8388396	-2	1.1561610	-6	4.3380483	-10	.....	..	-1.0 to .8
-200 to 400	2.8164207	-2	-9.0701000	-7	2.3070982	-11	.....	..	-10 to 7
0 to 400	2.5074243	-2	-4.4920686	-7	7.9942544	-12	.....	..	-.6 to .7
III. Quadratic Equation											
-270 to 0	1.5529911	-2	-3.9044069	-6	.....	..	.....	..	-20 to 10
-200 to 0	2.1878624	-2	-2.3425024	-6	.....	..	.....	..	-.4 to 3
-200 to 400	2.7401364	-2	-4.3784364	-7	-33 to 19
0 to 400	2.3610934	-2	-2.1980131	-7	-3 to 3



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16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.) Revision of the International Practical Temperature Scale requires that there be changes for all accurately tabulated thermophysical values. Revised reference data for thermocouples have been generated in a cooperative program between groups of the National Bureau of Standards in Boulder and Gaithersburg. This Monograph contains tables, analytic expressions, various approximations, and explanatory text. Only the standard letter-designated thermocouples are described: noble metal Types S, R, and B and base metal Types E, J, K, and T. Their appropriate "single-leg" or thermoelement versus Pt-67 values are also included. The new reference data reflect not only revisions in the temperature scale, but also slight changes in the materials themselves and improvements in data fitting methods. The temperature ranges vary for different types, from a low of -270 °C for Type E to a high of 1820 °C for Type B. The main functions and tables are given in terms of Celsius degrees and microvolts. Tables in the appendices represent the data with less precision, in millivolts, and in degrees Fahrenheit as well as Celsius. Approximate quadratic, cubic, and quartic analytic expressions are also given for each thermocouple type in various temperature ranges.				
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